...ineering
...ary

Engineering News-Record

McGraw-Hill Publishing Company, Inc.

✦

25 cents, $5 per year

ROADBUILDERS' REPORT NUMBER

Also in this issue:

Gate Lifting Equipment for Welland Canal

Floodlighting for Construction Work

Sludge-Bed Cleaning Machines at Chicago

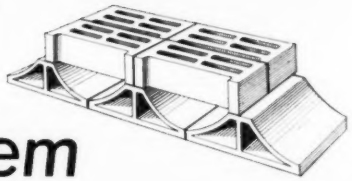
Concrete Arch Bridge at Aurora, Illinois

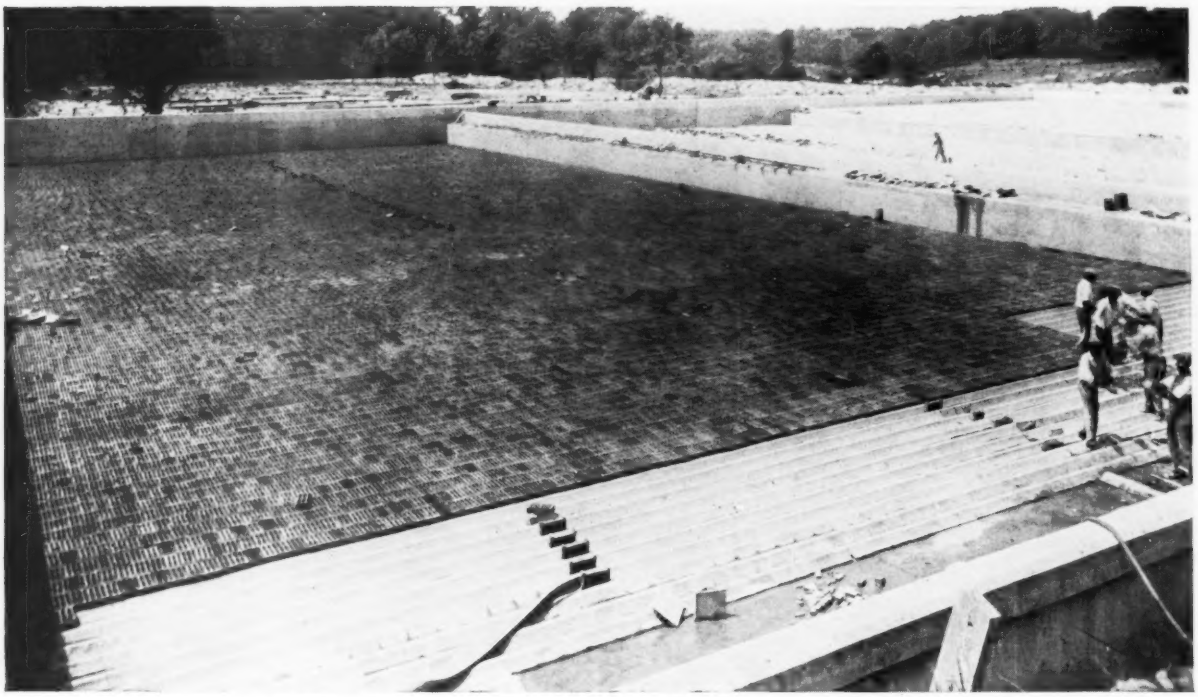
Reviews of New Engineering Books

Pontoon gate lifter raising a 500-ton gate leaf in the Welland Canal

January 21, 1932

Consider the "Pores" of Your Sewage Filter System





Metro Installation at Greenville, S. C. — J. E. Sirrine Co., Consulting Engineers — Tucker & Laxton, Contractors

"METRO" Vitrified Filter Floors are the best known application of an old principle—that of letting the filter breathe. Although the filter-method of oxidation has long been recognized and employed, it remained for Metropolitan to develop a filter bottom that provided "pores" large enough to correspond with the voids in the filter stone above.

"METRO" Grill Block is slotted in such a manner as to provide free openings which represent 43% of the total floor area. This corresponds with the 40-45% voids in the filter media.

Supporting the Grill Block floor is the base of "METRO" Channel Block. The size and shape of this lateral drainage arrangement are sufficient to carry away the effluent promptly, make flushing possible and afford plenty of room for the circulation of air. The air, which is sucked into the filter through the drain—and so necessary to adequate oxidation—is never retarded by the "METRO" Grill Block floor, because its pores can breathe.

A sample miniature of the "METRO" Filter Floor Unit (consisting of Grill Block and complementary Channel Block) will be sent to Engineers, Contractors, or Municipal Officials on request.

•

THE METROPOLITAN PAVING BRICK CO.

CANTON, OHIO

Manufacturers of Metro Canton, Bessemer, Olean, and Cleveland Paving Block • Architectural Face Brick • Structural Clay Tile • Metro Trickling Filter Flooring •

Metropolitan
TRICKLING FILTER FLOORING

Engineering News-Record

Established 1874 ✦ A Weekly Journal of Civil Engineering and Construction Practice ✦ McGraw-Hill Publishing Company, Inc.

F. E. Schmitt, Editor

Volume 108 | New York, January 21, 1932 | Number 3

The Road Show

ANOTHER road show has gone into history, and has given renewed proof of the virility of road engineering and construction. Whoever visited the show could be in no doubt as to the magnitude of highway problems or the seriousminded attitude with which road builders approach these problems. Though many picturesque and sensational types of machine—shovels, graders, mixers and pumps—were absent, the Detroit show retained all the stimulating and instructive value of the past. Its educational influence, though difficult to gage quantitatively, was undoubtedly great. Even beyond this the effect of the display upon the exhibitor invites reflection. Equipment development received powerful impetus, and its adaptation to the advancing requirements of the current art was put to the test of public scrutiny. In all respects last week's exhibition gave as good an account of itself as did its predecessors during many years. The road show has become more than an event—it is an institution. In future it may perhaps gain further value by concentration; the show is bewilderingly big, and a class show might achieve more instruction and stimulation. But any critical reflections must take second place to praise for the men and the companies who made the show and the great assemblage of visitors whose roadbuilding work will be bettered by their attendance.

Leading Articles

Sludge Bed Cleaning Machines....82
Welland Canal Gate Lifter.....86
Concrete-Arch Bridge at Aurora, Ill.89
Jack-Knife Draw Bridges.....93
Estimating Welded Buildings..... 94
Strength of Natural Cement Mortar.96
American Road Builders at Detroit.97
Asphalt Paving Technologists Meet.99
Road Show at Detroit.....113

Old Mortar Is Strong

A RARE contribution to available data on cement performance is made by the 35- and 50-year mortar strength records brought to light by P. H. Bates, as reported this week. It adds conviction to the interesting recital of successful service of concrete in the Tunkhannock viaduct given by M. Hirschthal last week. All confirmation of the general belief that cement and concrete do resist the tooth of time is valuable reassurance, in view of the misgivings occasionally voiced as to disintegration by weather and by the stresses set up in never-ceasing volume changes. The Louisville footings give proof that expansion and shrinkage are not the potent destroying agents they are often feared to be, and also that the risk of chemical attack in normal weather exposure may be ignored. Their evidence as to natural cement, and the Tunkhannock evidence as to portland cement, effectually support current engineering practice. Well-made concrete—for even the process of forcing stone into the mortar as at Louisville can produce good concrete—seems to be durable in both solidity and strength. That there is much bad concrete, and that such concrete often deteriorates rapidly, merely reinforces the recognized truth that all concrete is worth making in the best possible way, and that way only.

Time for Action

IN THE face of disturbingly large dismissals of engineering forces during recent weeks—the Detroit dismissals were noted in this column last week—the need for engineering cooperation to assist the unemployed becomes even more urgent than before. What the local engineering groups have done up to the present is in most cities little more than a beginning, but it now becomes clear that much greater energy must be put into the relief cooperation if it is to be of any use. Winter has not yet begun in earnest, and the most imperative need is in the two or three months just ahead. There is still hope that strong action by the national government and the central financial authorities will relax the stringency of credit and permit of early resumption of the normal activities that have been interrupted, especially in the field of public works. But this hope is too slender a reed to lean on under the burden of present needs. The many engineers who find themselves in serious straits because of unemployment and frozen assets must have help from their colleagues. The times call loudly on the local groups that have not already done so to set to work in providing this help.

Deflation Effects

MONEY troubles of cities and states grow apace as the result of extreme deflation. Reduced tax income, poor collections and tight credit are felt all over the country. When Detroit has to stop construction work that is nearly completed, South Carolina is unable to sell its bonds, and North Carolina is forced to defer all roadwork except federal-aid, the gravity of the situation is plainly apparent. Even the city of New York, wrestling with the problem of getting temporary money to meet obligations due, is planning to stop much construction. There is talk of wasteful administration and excessive tax burdens, but no proof. The fact is that public administration on the whole is of very fair efficiency, probably comparable to that of corporation management. But taxpaying is naturally difficult in these impecunious times, so that much delinquency is ex-

perienced everywhere and enforcement of collection by foreclosures and tax sales are in many regions practically impossible, or if possible would further depress values that already are so depreciated as to threaten the entire assessment system. Such extreme effects of the country-wide collapse of values constitute the most troublesome phase of recent developments, and indeed warrant feelings of grave alarm. It is the cities and states that bear the entire responsibility for unemployment relief, yet these very agencies are rendered impotent at the time when freest possible expenditure is necessary to prevent further growth of unemployment and distress. Since the root of the trouble evidently lies in money tightness, and this is largely subject to the control of federal authorities, it is to be hoped that Washington will act promptly to devise means by which the growing shortage of public-works finance may be corrected.

Make Work by Modernizing

THAT there is work enough for all has been said so many times as to be thoroughly familiar, yet there remain those who look upon relief by jobs as sugar-coated charity. For the benefit of such, the demonstration afforded by the reconnaissance of the water-supply field which we reported last week merits further mention. A great volume of useful and profitable modernization awaits doing all over the country. Were all the needed modernizing of municipal services carried out during the current year, the problems of idleness and relief would virtually disappear. Our municipal water systems alone can profitably use hundreds of millions of dollars, yet these systems are among the most fully developed and best maintained parts of the country's service equipment; much more extensive needs for modernization can be found in other departments of public works, as well as in industry. At the present time, with labor desperately seeking employment and with prices at their very lowest, a rare opportunity is offered for modernizing our backward equipment. Without this modernization we are bound to go into the future handicapped by inferior equipment though facing a competition that is becoming even more severe. Modernization plans, therefore, should be made the basis of all present efforts to provide employment, and made work expenditures that do not promote modernization should be challenged on the score of wastefulness. Surveys like that proposed of water supply, if carried through in all public-works fields and developed to the stage of definite projects, can lay a solid foundation for construction employment work. On this basis sound plans could be formulated for public credit relief, assuring that every dollar advanced will be a secure investment. There is work to be done by engineering and industry associations in their special fields; their detail knowledge can most quickly provide the needed survey data.

Public Confidence Essential

CUSTOMER ownership as an asset to a public utility had one of its first tests in St. Paul recently. The results indicate that a utility can count for little help from that source if the public suspects that it is not getting a square deal from the utility. The Northern States Power Co., which supplies the city with light, steam heat and gas, sought to renew its franchise. The city submitted a contract to the company which called for the continuance of the 5 per cent gross-earnings tax which the utility now pays in addition to a property tax, and also called for a complete revaluation of the company's property as the basis for a revision of rates because of a widespread belief that rates were too high. This the company refused to accept, asking instead elimination of the gross-earnings tax and no revaluation until 1940. Therefore a revised contract was put to public vote, without definite provision for a revaluation and without the sales tax. In its support the power company organized a stockholders' committee and put on an active campaign. The opposition not only published a list of private concerns in St. Paul that generate their own electricity but also circulated a diagram showing the pyramid of ownership through which control of the power company is passed up to holding companies, and charged that the latter drain off the profits of the local company by means of engineering, financing, construction, management and many related fees. The contract lost, by a vote of five to one. Thus, regardless of the merits of the claims of either side, the fact stands out that a large group of customer stockholders will not offset a loss of public confidence. The company has 11,400 stockholders in St. Paul; the votes stood 8,760 for and 42,508 against the franchise.

Recording an Art

WHAT was accomplished by the roadbuilding profession in its Detroit convention last week merits distinguished appreciation. The collection of papers and committee reports laid before the convention constituted so full a record of the current art of road construction in its major phases that it earned for itself a lasting place in our technical literature. Despite dilution by some matter that merely repeated the well-known and the obvious, it presented in substance an authoritative handbook of the modern art. This performance, going far beyond any prior accomplishment of the Roadbuilders' Association, marks a high point in the organization's upward path toward constructive leadership in creating and disseminating roadbuilding knowledge.

At Detroit the unusual importance of the convention was hardly apparent. The sessions, with few exceptions, were poorly attended, drab, and bare of discussion. Not much more can be expected from meetings held in scattered gallery cubbyholes alongside a boisterously crowded exhibition pavilion. This regrettable weakening of what might have been a convention of inspiring and resultful technical interest is not new. It marked earlier conventions in quite the same degree, but it was more keenly felt this year because of the very excellence of the report material which the labors of committees and authors had produced. Yet, harmful as it was, the meeting arrangement in no way lessened the value and significance of the solid production—the reports and papers themselves.

Roadbuilding is a rapidly advancing art, and because of that fact it finds exceptional value in such recording as was accomplished by the convention. In its modern aspect the art is youthful, vigorous and promising of a large future. Everyone connected with it realizes its immaturity; progress is in the air, and highway engineer as well as constructor is alert to detect new needs and movements, learn of new practices and weigh the experience had with various types of structure. In such atmosphere it is of unusual service to have a periodic record of method and practice, a record that may serve as a

point of orientation, from which new progress can start. Until this year the association did not produce such a record. Now that it has achieved the step, it may well make similar recording of the art its first objective in the program for future years.

For more than one reason the present is a peculiarly fitting time for appraisal of the state of the art. Drifts perceptible not only during the current business stringency but even during the lush times of 1928 and 1929 were steadily tending to bring to the front new demands. On the one hand the call for low-cost roads for secondary and tertiary service, on the other hand higher requirements as to location and design of main thoroughfares, directed attention to the need for restudy of practice standards and for wise forecasting of future factors of highway transportation. The 1930 International Road Congress at Washington brought a further stirring of thought, inasmuch as it was a forceful reminder of the vast opportunities for pioneer roadbuilding in many distant countries, a field which found but limited utility in our own accumulated experience. And, finally, service experience began to tell something of durability and life of road structures, teaching the lesson of more thorough attention to long-time values. Such factors as these are influencing the roadbuilder's art and are laying new courses for advance. Coming progress, it is clear, depends quite directly on the accumulated knowledge of the art.

And on similar grounds it is evident that great value will attach also to the succeeding records of roadbuilding practice which the American Roadbuilders' Association may compile. For years to come there will be fruitful occasion for comprehensive annual summaries of the art. The experience of this first year points to ways in which these later records may be made by greater utility—by concentration, by careful planning of the report schedules to eliminate non-essentials, and perhaps also by rigid selection of subjects to confine the work to major trends of change. Such refinement may be difficult, but its dividends so far outweigh its cost as to justify strong effort to attain it. In short, the work done by the association in its 1932 convention, praiseworthy as it is, forms but the beginning of a continuing service to which the roadbuilding profession confidently looks forward.

Divided Control of Power

IMPORTANT questions relating to the control of electric utilities and of the interstate transmission of power are raised by the Federal Power Commission in the first annual report of that body since its reorganization. The commission would have all electric utilities make uniform reports to it of their financial transactions and current operations, similar to those now submitted to the Interstate Commerce Commission by the railroads. In addition, the commission seeks the right to regulate the interstate transmission of power wherever state commissions are unable or unwilling to function.

The commission asserts that it does not seek a lessening of state control. Rather, it seeks an extension of both state and federal control despite some possible overlapping. In other words, it hopes to obtain more satisfactory control of power through a division of regulating control between state utility commissions and a federal commission vested with much broader powers than it now possesses. Few will deny the need for more adequate control over electric utilities, especially over their financial set-up and over the interstate transmission of power. The only open questions, then, in what the commission recommends are whether the sort of control it proposes is desirable, and whether division of control between state and federal commissions is practicable.

Uniform financial and operating reports from all utilities are much to be desired. The very necessity of having to submit detailed statements of financial transactions to public analysis will go a long way toward stopping practices which in recent years have brought about increasing demand for more complete regulation of electric utilities. Obviously the collection and publishing of such reports should be a federal function. It could be delegated to the Federal Power Commission without vesting that body with regulatory powers. Whether that body should have regulatory powers to control the interstate transmission of power is not so clear.

Interstate transmission of power now is largely unregulated; this condition has been used to avoid state regulation and may be expected to provide other instances as interstate transmission increases. In one notable instance, that of the Conowingo hydro-electric plant, control over a power development of interstate character was set up by joint action of the utility commissions of Pennsylvania and Maryland. The Federal Power Commission cites this case as an example of how interstate operations may be handled. It believes, however, that uniform provisions should be made for setting up regulatory agreements between adjoining states, and that the federal commission should be empowered to take jurisdiction when the states do not or cannot exercise control through such joint agreements.

The theory of this plan is sound. Whether it can be worked out successfully in practice is another question. Judging by what has taken place in the regulation of railroads, more and more power will pass to the federal commission as years go on. While the cases are not exactly parallel, like conditions control. So long as there is a federal body with regulatory powers, the utilities, failing to get the consideration that they think is due them from state regulatory commissions, will find ways of getting their case before the federal commission; and the federal commission, following a very natural inclination, will not be averse to taking jurisdiction, thus expanding its power. We have the recent case of the Interstate Commerce Commission's assumed right to say whether the Whitestone branch of the Long Island Railroad should be abandoned. If there ever was a case in which it was more evident that final jurisdiction should have rested with the state commission it would be hard to find; yet the federal commission took control, and the Supreme Court has ruled that it had the right to take control away from the state.

In view of these conditions it is questionable whether dual control over electric utilities is practicable, or, better, it is doubtful whether it can be made permanent. Despite this consideration such a plan coupled with one which will facilitate maintaining the largest possible part of the control of utilities in the hands of state commissions is well worth trying. What happens in the future will rest largely with the states. If they will cooperate and will maintain the maximum amount of uniformity in the regulation of utilities the major part of the regulation will remain in their hands, but if they will not cooperate and insist upon setting up radically different forms of regulation upon opposite sides of state lines more and more regulation may be expected to pass to the federal regulating body.

Cleaning Machines for Large Air-Drying Sewage Beds

Equipment developed for The Sanitary District of Chicago consists of fork-like pick-up apron with elevating buckets—One machine strips the whole width of bed and another shuttles transversely

By L. P. Kane and Langdon Pearse
Engineer of Treatment Plant and Sanitary Engineer, respectively, The Sanitary District of Chicago

REMOVAL of air-dried sewage sludge from drying beds and its final disposal is a major problem in the operation of large sewage-treatment works. In the small plant the solution is found in relatively small unit drying beds, and in man power sometimes supplemented by a narrow-gage railway. In large plants, such as the new West Side works of The Sanitary District of Chicago, where 2,000 to 3,000 cu.yd. of air-dried sludge a day must be handled during drying weather, the problem is much more formidable. The solution at Chicago is found in specially designed large-unit drying beds, machine stripping of the dried sludge, and a standard-gage railway for hauling the removed material to the dumping grounds.

Two self-propelled cleaning machines now do the work, three men on a machine, assisted by two helpers. One of these machines was put into operation by The Sanitary District of Chicago in the fall of 1930, the other in the summer of 1931.

• The conventional sludge-bed design for smaller plants, developed from the type in use in the Emscher District in Germany about 1909, involves a width of bed from 16 to 25 ft., and a narrow-gage track through the bed. (The dimensions of the principal beds in the United States were summarized in *Engineering News-Record*, July 3, 1924, p. 14.)

The West Side works (Fig. 1) are being planned to treat the sewage of about 2,000,000 people, and in addition handle the sludge from the North Side plant, serving a population of some 1,250,000. This sewage may produce from 350,000 to 400,000 cu.yd. of air-dried sludge per year. In the drying season from 2,000 to 3,000 cu.yd. per day may be expected. On this amount the use of the machine cleaners will save the labor of from 350 to 400 men.

A Chicago Development—When the design of the West Side works was started, in 1924, the size of the plant indicated the need of developing a new type of sludge-drying bed and sludge-handling equipment, and the advisability of replacing hand by machine cleaning. The first step was to determine how far sludge would flow effectively on the beds. Many operators felt that 100 ft. was the limit. In extending the Calumet drying beds in 1925, units 35x105 ft. were built, with feed piping arranged to test the proposed procedure on the West Side beds.

During 1924 a study was begun looking to the design of a sludge-bed clean-

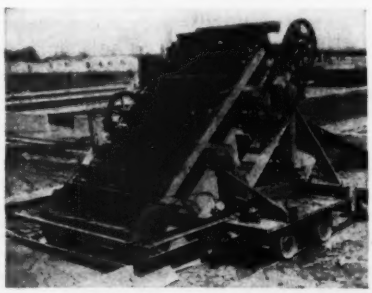
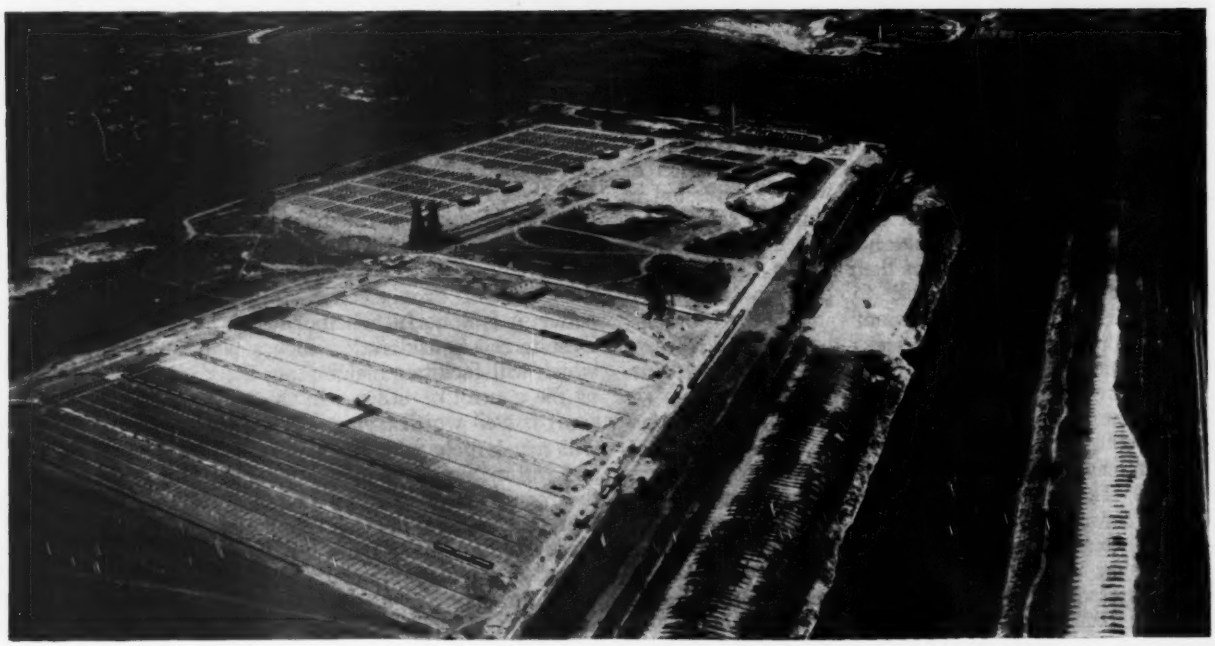


Fig. 1—West Side sewage-treatment works with sludge-drying beds in the foreground being filled with sand. Imhoff tanks are shown in the background.

Fig. 2—First experimental machine (left) was 5 ft. wide and showed possibility of stripping sand and elevating sludge. The final machine (right) cleans the full area of an 80x1,200-ft. bed in continuous longitudinal travel, discharging the sludge into gondola cars alongside.



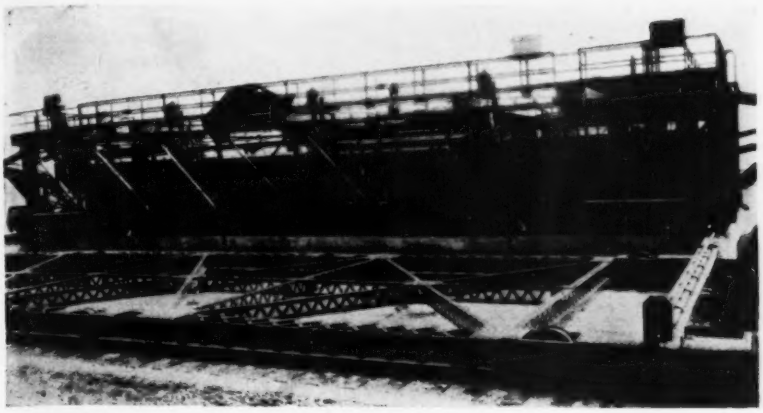


Fig. 3—At the ends of beds the machines are run out of transfer bridge (foreground) that moves them transversely to the next bed to be cleared.

ing machine to work on beds upward of 75 ft. wide. The basic idea was to use a set of fork-like prongs, following the practice of using manure forks in hand cleaning. In this way as little sand as possible would be picked up. The first tests were made with a trial carriage 5 ft. wide running on rails laid in the bed (Fig. 2). On the carriage was supported an inclined steel apron, carrying the teeth. An elevating drag scraper pulled the sludge up the apron. This apparatus showed that it was possible to strip air-dried sludge from the sand and carry it up an incline. Further studies were made in 1926 and 1927 to obtain the fundamental design data (coefficient of friction, the type and spacing of teeth or forks, the best angle of the apron to promote sliding upward, speed of travel and power requirements). In 1927 a machine 20 ft. wide was constructed. The use of rails laid in the bed was discarded because of the interference with the sludge and teeth. Self-contained crawler types were investigated also. The final choice was a traveling bridge, supported by rails on the walls of the bed, carrying teeth that would be pushed under the cake on the surface of the bed and would allow the sand to drop through at the same time that a continuous drag scraper pulled the broken chunks of sludge up an inclined apron and onto a traveling belt running across the beds and discharging the sludge into railroad cars.

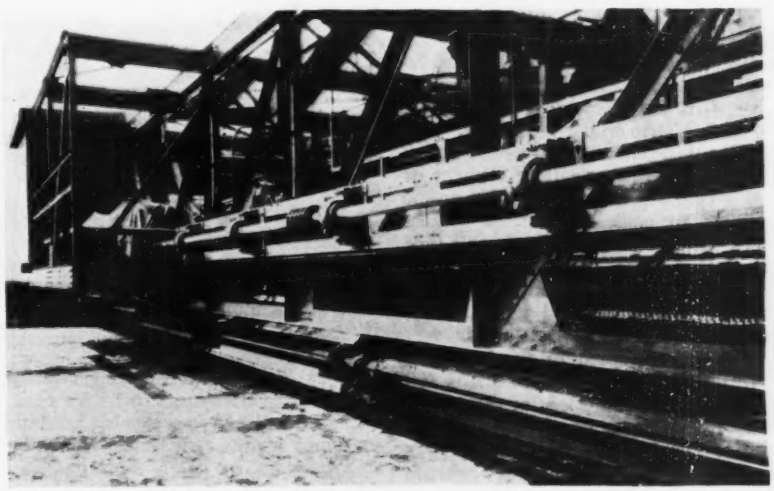
From these trials the machine now constructed was designed by the staff of the Sanitary District, bids taken in 1930 and the machine built by A. J. Evers and H. J. Sauvage. The contract price of this machine was $87,000, erected in place. The transfer truck cost $17,050, also erected in place.

Instead of the conventional sludge bed with units from 16 to 25 ft. wide and from 80 to 200 ft. long (*ENR*, July 3, 1924, p. 14) with a narrow-gage track in the bed, the West Side works has drying beds 80 ft. wide by 800 to 1,400 ft. long built in pairs, with a standard-gage track between successive pairs. Additional beds of a maximum length of 2,000 ft. will be built. The concrete wall on either side carries a 90-lb. rail, 81½ ft. c. to c. One end of the drying beds is served by a transfer truck (Fig. 3) so that the cleaning machine can be transferred to any bed. Sludge is discharged onto the beds by outlets spaced 80 to 110 ft. on centers along the common wall. When ready for removal the sludge is expected to average from 3 to 6 in. thick and weigh 55 lb. per cubic foot (55 per cent moisture).

Because of the necessity of clear walls with regard to ease in operation and the overhang of the discharging belt, overhead trolley wires proved impracticable. Third-rail service was dismissed as dangerous, not only because of the exposure but also because of the possible splashing of wet sludge. Consequently the type of drive was narrowed to gasoline and a self-contained electric unit. Because of the desirability of several speed controls for different devices, the final choice was a 50-kw. gasoline-driven generator set on the machine, driving eight electric motors. Two motors propel the machine, one of 20 hp. for high speed and one of 5 hp. for slow speed. The flight conveyors are driven by a 20-hp. motor, the belt conveyor by a 5-hp. motor. The four flight-conveyor hoists each have a 1½-hp. motor.

Cleans 80-Ft. Width—As built, (Fig. 2) the Sanitary District machine weighs 126 tons. Two main lattice girders, crossbraced, carry the mechanism. The teeth or fingers are ½-in. round curved rods, tapered to a point in 4 in.; they are spaced 2⅜ in. (giving 2⅛-in. opening) and are welded to the apron. There are four aprons; the lower portion of each is capable of vertical adjustment. As the machine runs forward, the teeth pass under the sludge and break the cake; this slides up the teeth onto the apron, where a flight conveyor (one for each apron) pulls the sludge up an inclined table at 20 ft. per minute and delivers it to a 36-in. rubber belt running the length of the bridge and extending out over the dump car at the end.

Fig. 4—Teeth (raised) pass under sludge, breaking the cake. The removed sludge slides onto the apron, where flight conveyors pull it up the incline to a traveling belt.



The belt has compound motor drive, for a belt speed of 200 ft. per minute; the machine has a propelling speed for cleaning from 3 to 7½ ft. per minute, and a reverse speed of 100 ft. per minute. The capacity is 5 cu.yd. per minute. The cleaner is intended to take the sludge continuously from the whole 80-ft. strip between the walls as the machine moves along the walls.

The operators stand in a cab, where they can control all motions. From a platform on top of the machine a captain directs all operations and coordinates the movement of railroad cars with the movement of the machine. Brakes, lights and a signal system are provided.

Shuttle Type—Another type of machine has been built from designs prepared by Evers and Sauvage on the basis of their experience with a small

Fig. 5—The first Evers-Sauvage machine at Calumet (left) shuttles back and forth, cutting a 4-ft. strip, while the perfected unit for the West Side works cuts a 12-ft. swath with a traveling unit.

machine (Fig. 5) developed for the Calumet works in 1928 and 1929. Their large machine (Fig. 5) differs from the District machine in that the cleaning element is relatively narrow, being intended to travel across the bed, removing a 4-ft. strip of sludge at Calumet and a 12-ft. strip on the West Side. The machine then moves sideways and a new cut is made. The cleaning element or trolley consists of an adjustable frame carrying an endless chain of buckets armed with cast-iron teeth. In this type the cutting edge of the buckets advances into the sludge layer approximately at sand line and turns, lifting the chunks of sludge.

The forward speed of the bridge is 30 ft. per minute and the return is 100 ft. per minute. The speed of the trolley on its return for a new cut is a maximum of 173 ft. per minute, and on removing sludge, 30 to 73 ft. per minute. The speed of the main-delivery conveyor belt is 450 ft. per minute, the cross-conveyor belt 300 ft. per minute and the bucket elevator chain 168 ft. per minute. The speed of hoisting or lowering the bucket elevator frame is from 2 to 3 ft. per minute. The power unit on the machine is a 30-kw. generator set, driven by an 86-hp. gasoline engine.

The bridge is driven by a 10-hp. reversible motor with magnetic brake. The main belt is driven by a 5-hp. motor, and the cross-belt by a 1½-hp. motor. The bucket elevator on the trolley has a 20-hp. motor for its drive and a 5½-hp. motor for the frame adjustment, both having magnetic brakes. The trolley drive is a 10-hp. planer-type motor, with adjustable speeds, to provide 450 r.p.m. for 3-in. sludge, 250 r.p.m. for 6-in. sludge, and on the return 1,000 r.p.m.. The motor is equipped with a magnetic brake.

The Evers-Sauvage machine (Fig. 5) at the Calumet works operates on a bed 64 ft. wide. The span of the machine is about 64½ ft. c. to c. of rails, and the weight is 20 tons. The cutting buckets have a width of 4 ft., making an effective cut across the bed of 3½ ft. allowing 6 in. for overlap on each cut. When operating at a digging speed of 20 ft. per minute on sludge 6 in. thick, the machine handles 1 cu.yd. per minute. Probably a higher capacity can be obtained from this machine by increasing the digging speed to 40 ft. per minute, the return speed of carriage from 60 to 100 ft. per minute, and changing the track layout and operation of narrow-gage cars to reduce delays.

* * *

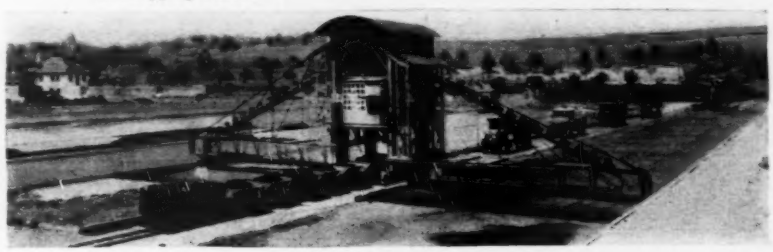
A description of sand-filter or sludge-stripping devices would not be complete without mentioning the Blaisdell, the Worcester (Mass.) and the German schemes.

Other Types—The machine cleaning of sand beds first came to public notice in the Blaisdell filter-scrapping machine, developed for the slow sand water filters at Pittsburgh in 1905. This had as a forerunner the scraping machines developed by Blaisdell in the mining industry for cleaning filters in the cyanide process. The operation of the Pittsburgh machine stopped shortly after its installation. Cleaning sand filters and cleaning sludge from drying beds, however, are somewhat different operations.

At Worcester in 1926 an effort was made to reduce the cost of hand cleaning on the old intermittent sand filters, which had been converted into sludge-drying beds. The 1-acre unit beds were practically square, surrounded by earth dikes. Horse-drawn four-wheel scrapers threw the air-dried sludge into windrows 6 ft. wide, which were then loaded into horse-drawn carts by an elevating bucket loader. The most recent figures (see report of superintendent of sewers for year ending Nov. 30, 1930) shows costs for sludge removal of 31c. per cubic yard for hand cleaning, and 20c. for the scraper-loader method, exclusive of hauling from the bed to the dump. The machines removed much sand. The loader was mounted on crawlers with 14-in. treads instead of the 10-in. tread ordinarily used, with a bearing load of 6.3 lb. per sq.in. Special plows were built on each side of the revolving disks. The movement of the loader left the sand in a rough condition. After the bed had been stripped the surface was screeded and brushed with a large bundle of birch twigs to a fairly uniform even surface. The organization used with the loader consisted of one foreman, one operator, two men at the loader, two men on the dump and three to five horse-drawn 2-yd. wagons. The average haul was about 600 ft.

In the German sewage-works two types of machine have been developed since 1926. One is built by the Jacob Hilgers Iron Works and is in use at Stuttgart. (See *Gesundheits-Ingenieur*, 1928, Heft 3, pp. 40-41.) Through the courtesy of C. E. Keefer, of Baltimore, there is shown a photgraph (Fig. 6) of this machine, taken in 1927. It

Fig. 6—In the cleaning machine in use at Stuttgart, Germany, a cantilever frame balanced over a tower carries the chain of stripping buckets.



comprises a cantilever frame balanced over a tower, carried on rails between the drying beds. The cantilever frame carries a chain of movable buckets traveling at 11.8 in. per second. These buckets are 13.8 in. deep, 11.4 in. square at the open end and each contains 0.56 cu.ft. As the tower moves, the buckets are forced into the sludge at the surface of the sand and the sludge enters the buckets, which finally pass over the car on a track under the tower and are dumped. The machine has a capacity of 65.4 cu.yd. per hour with both arms in operation. The beds at Stuttgart are 36 ft. wide and 295 to 376 ft. long. The space between the beds for the traveling device is 11½ ft. wide. When removed, the sludge contains from 50 to 60 per cent moisture. The buckets on the machine are adjusted to clear the surface of the beds by ½ in.

The other machine is in use in Berlin at the Wassmannsdorf works. (See *Gesundheits-Ingenieur*, April 20, 1929, pp. 252-258.) It is of traveling bridge type, serving drying beds arranged in a rectangular shape, with a circular end, so that the machine can swing around the end. There are two rows of beds, one on each side of the central wheel. The roadway parallels an outside team-track wall, to which sludge is delivered.

The unit beds are 80.7 ft. wide and 62.3 ft. long in the direction of travel. There are ten of these unit beds on each side of the dividing wall. The machine is said to handle daily 104.6 cu.yd. of air-dried sludge.

* * *

At the West Side works it is also proposed to have a resanding machine. Probably 15,000 cu.yd. of sand a year will be required. The machine will comprize units to remove the sand from standard-gage cars and distribute it evenly across the bed. In the construction of the beds the contractor, Warner Brothers Construction Co., used a traveling bridge carrying a storage hopper and moving belt, as described by N. E. Anderson (*ENR*, May 14, 1931, p. 800).

The work at The Sanitary District has been carried out under the direction of E. J. Kelly, chief engineer, by the engineering staff, and in particular, I. P. Kane, engineer of treatment-plant design, L. C. Whittemore, engineer of design, John T. Hawley, electrical engineer, H. I. Steffa, mechanical engineer, and Langdon Pearse, sanitary engineer.

Formula for Economic Hydraulic Gradient for Conduits

Factors of present worth of loss in head, capital cost and relation of cost to size are combined

By Raymond A. Hill
Consulting Engineer, Los Angeles

FOR any type of conduit and for any quantity of water, the most economical hydraulic gradient depends upon three basic factors: first, the present worth of a unit loss in head; second, the unit capital cost of a conduit of that type and of definite size; third, the rate of change in capital cost relative to size. For any fixed size of conduit the capacity varies practically as the square root of the slope; conversely, for any fixed quantity the size varies as the reciprocal of that function. Generally, the capital costs of conduits of similar proportions vary as a fractional power of the size. Hence within reasonable limits the quantity of water carried at any hydraulic gradient and the unit capital cost of any conduit can be determined from the same factors for two similar conduits of arbitrary sizes.

In the subsequent derivation the following general symbols will be used and these are independent of the system of units:

Q, quantity of flow per unit of time.
S, absolute hydraulic gradient.
S_e, economic hydraulic gradient.
A, effective area or size of conduit.
C, capital cost per unit of length.
C_e, unit capital cost at economic gradient.
W, present worth of a unit loss in head for a unit quantity.

The derivation also involves certain constants, a, b, d, k, m and n, some of which are fixed by original data, while others are dependent upon those constants.

The cost of similar conduits is a function of their effective cross-section area and may be expressed as

$$C = aA^m \qquad (1)$$

and since the cost of two sizes are known the constants a and m are fixed and the cost of any similar conduit can be determined.

The capacity of a conduit, from Manning's formula, is:

$$Q = kAS^{1/2}R^{2/3} \qquad (2)$$

and for similar conduits

$$R = dA^{1/2} \qquad (3)$$

hence the capacity of such conduits may be expressed as

$$Q = bA^{4/3}S^{1/2} \qquad (4)$$

where $b = kd^{2/3}$ (5)

and the effective area as

$$A = \left[\frac{Q}{bS^{1/2}}\right]^{3/4} \qquad (6)$$

Then from equations (1) and (6)

$$C = a\left[\frac{Q}{bS^{1/2}}\right]^{\frac{3m}{4}} \qquad (7)$$

Substituting n for $\frac{3m}{4}$

$$C = \left[\frac{aQ^n}{b^n S^{n/2}}\right] \qquad (8)$$

The present worth of the loss in head for a unit length of conduit and for any quantity may be expressed as the product of Q, S and W, and the total cost per length of conduit is then equal to

$$QWS + \frac{aQ^n}{b^n S^{n/2}} \qquad (9)$$

Differentiating and solving for the economic slope

$$QW - \frac{naQ^n}{2b^n S_e^{1+n/2}} = 0 \qquad (10)$$

$$S_e^{1+n/2} = \frac{an}{2b^n Q^{1-n}W} \qquad (11)$$

and

$$S_e = \left[\frac{an}{2b^n Q^{1-n}W}\right]^{\frac{2}{2+n}} \qquad (12)$$

From equation (10)

$$\frac{aQ^n}{b^n S_e^{n/2}} \times \frac{n}{2S_e} = QW \qquad (13)$$

and from equation (8)

$$C_e = \frac{2QWS_e}{n} \qquad (14)$$

The capital cost of any conduit operating at the most economical hydraulic gradient is thus directly proportional to the present worth of the head lost in that conduit and the economic slope is determinable from the rate in change of cost of conduits of arbitrary size.

Where the Railway Dollar Goes

Recently the Pennsylvania Railroad gave out an analysis of its expenditures during the year 1930 based upon the distribution of each dollar of income. The figures are given below.

	Cents
To employees, for wages	45.49
To the mining industries, for locomotive fuel	3.75
To manufacturers and dealers, for materials and supplies	15.01
To federal, state, county and municipal governments, for taxes	6.37
To other companies, for rentals of equipment and joint facilities	2.74
To claimants, for loss, damage, etc.	2.03
To bond and mortgage holders, and others for fixed charges	7.53
To reserves, for depreciation and retirements	3.60
To stockholders, for dividends	9.09
To miscellaneous payees, for all other expenditures	1.84
Leaving available for surplus	2.55
Total	100.00

Nearly half of every dollar was paid out directly in wages, and when the amounts paid for fuel and for supplies are considered, it is probable that more than half the income goes to labor costs. Also, the amount paid to federal, state, county and municipal governments in taxes is only slightly less than what the stockholders receive in interest.

Welland Canal Gate Lifter Subjected to 500-Ton Test

Floating hoist designed to operate in limited lock chamber found stable under heaviest pontoon lift ever attempted

By A. F. Case

Engineer, Wellman Engineering Co., Cleveland, Ohio

TEST of the gate lifter recently completed for the Welland Ship Canal under maximum load was carried out Oct. 30 at Port Weller, Ontario. The performance of the pontoon crane under these maximum conditions was extremely satisfactory. It handled the largest lock gate with such ease that it was difficult to realize that a 500-ton load was being raised by a floating structure. This operation eclipses all past performances of floating structures in capacity. Never before was such an enormous weight lifted by a single pontoon-mounted hoist, capable of fine manipulation.

The purpose of the gate lifter is to change the lock-gate leaves when necessary, removing a damaged gate, or a gate in need of repair, and setting a spare leaf in its place. Three different sizes of gates are used at various points in the locks. They vary principally in height—35, 44 and 83 ft., and in weight—180, 230 and 500 tons.

It is necessary when handling the gates to work on the downstream side on account of the position of the mitre sills; and as the locks are only 80 ft. wide, the pontoon that carries the gate hoist is limited in size to that possible of manipulation in the lock chamber at an angle of about 40 deg. to the axis of the lock.

Early in 1929 the Welland Ship Canal employed the Wellman Engineering Co. as consulting engineers to design a gate lifter to meet the requirements of the service. The design of this equipment presented many difficulties on account of the limited size of the pontoon. For example, it was necessary to introduce a stabilizing girder to prevent the gate from swinging on the ropes while hoisting, in order to secure transverse stability of the machine. It was necessary, also, to provide shifting water ballast to adjust the trim of the pontoon under different load conditions, as the position of the center of gravity of the unloaded pontoon is quite different from the position when loaded and requires a shift of the water ballast forward or aft.

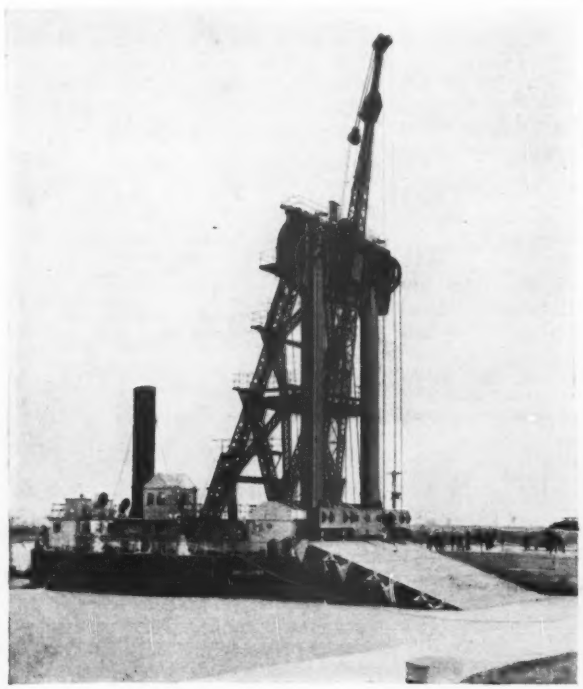
Pontoon gate lifter raising a 500-ton gate leaf in the Welland Canal. As the load on the hoist increases, the pontoon is kept on even keel by pumping water from the forward to the aft ballast tanks.

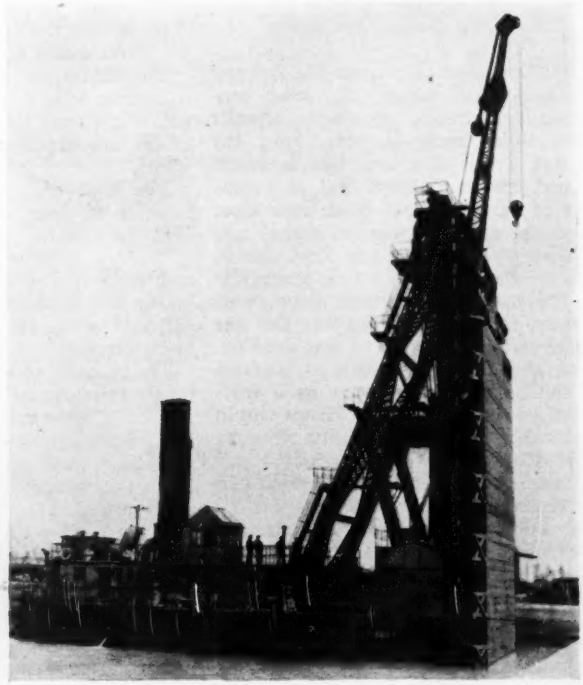
The lock gates are rights and lefts, and one side is considerably heavier than the other. For this reason it was necessary to provide means to shift water ballast from one side to the other in order to keep the pontoon on even keel.

Because of the large capacity of the hoist very heavy machinery is required. On the other hand, the importance of keeping the center of gravity low required a design that could be installed within the pontoon and occupy as small space as possible. Then it was necessary to install in the pontoon a power plant to supply direct current to the various operating motors and a boiler to supply the steam for the generator engine and control equipment.

For lifting purposes each gate is provided with four eyes to which the shackles of the gate hoist are attached. Two $2\frac{3}{4}$-in. cables are attached to each of the four shackles on the gate hoist and pass through the stabilizing girder, around sheaves on the top of the superstructure, thence around a sheave near the deck and around sheaves in a movable hoist carriage to an anchor in the plunger of an equalizing cylinder located at the front end of the pontoon.

The hoist carriage travels on a track below the deck and parallel to the longitudinal center line of the pontoon and is moved by means of a screw driven by a 50-hp. motor near the stern of the pontoon. There are four of these hoists, one for each lifting lug on the lock gate; and before the gate is lifted far out of the water, the four units are all clutched together so that both sides of the gate are evenly lifted. The load is first equalized by opening the valves connecting the four cylinders, thus allowing





the liquid in the cylinders to come to an even pressure, after which the valves are closed and the four hoisting motors lift the gate. As the gate is lifted farther and farther out of the water, the load on the hoist increases, and it is necessary to shift ballast to the rear of the pontoon in order to keep it on even keel. Three ballast tanks forward and three aft are required for this purpose. These tanks are served by three separate centrifugal pumps.

Also, as the load increases on the hoist, the heavy side of the gate tends to produce a transverse list to the pontoon, which is corrected by transferring water ballast to the high side. This is done by a separate pump provided for the purpose.

It is possible by means of the ballast system always to maintain the pontoon in trim.

All of these functions are controlled from a station in the deck house about amidships, where the operator can see everything that is going on. This operating station is provided with the electric controllers for the hoists and pumps, gages to show the trim of the pontoon, gages to show the amount of water in the ballast tanks, gages to show the pressures in the equalizing cylinders and valve controls for the ballast pumps and the equalizing cylinders.

In addition to the main hoist, the equipment also includes an auxiliary derrick of 35 tons capacity, which is used for handling valves and small loads.

The operation of the main-hoist equipment provides protection not only against mistakes of the operator, but against equipment failure, by means of an elaborate interlocking scheme. Travel of the hoists is limited by slow-down-and-stop limit switches, and it is not possible to raise the load past the lower position of the equalizing girder by means of individual control. Should the pressure in any equalizing cylinder exceed the predetermined setting, the hoisting cannot continue until this is rectified.

This floating crane is a self-contained unit, entirely independent of other pieces of apparatus, except that it is not self-propelling.

Preliminary tests of the crane in lifting the small and intermediate gates were made May 15, 1931. At that time, however, it was not possible to conduct the test on the 83-ft. gates, but late in October one of the spare 500-ton gates was towed to the gate lifter, and after the shackles had been attached the test was begun. Slowly the top of the gate was lifted from the water, and the pressure in the equalizing cylinders began to climb, indicating very accurately the increase in the load. The water ballast pumps were then started to keep the pontoon level. Frequent stops were made for observations and measurements, then the hoist was again started, and soon the top of the gate was so far out of water that the bottom end grounded in 27 ft. of water. From then on the pontoon was gradually pulled toward the gate until an upright position was reached. Very little power was used up to this point, as much of the weight of the gate was resting on the bottom. However, as soon as the gate was vertical, the hoist began to assume the load, and the gate was hoisted to its maximum height.

During the whole operation the pontoon was maintained on even keel, and the hoisting was so steady and gradual that no motion of the pontoon was at any time perceptible except the very gradual increase of draft as the load was assumed. The ballast at all times responded to the control perfectly. The machine was apparently as stable as if it had been on dry land and not a floating structure.

The lock gates that this lifter is to handle are of steel construction, horizontally plated with sheathing plates on both sides. They are so built that when openings in the sheathing plates are closed the gate leaves will float flat upon the water, in which position they may be transported from the storage in the gate yard to the lock where a gate requires replacing. Upon arrival at the lock the gate-lifting pontoon crane, after first removing the damaged gate leaf, will lift the new leaf from its horizontal floating position into a vertical position and place it upon its pintle.

When not in use, the pontoon crane will be kept in a basin adjoining the approach channel on the Lake Ontario side of lock No. 1 at Port Weller, Ont.

A description of the Welland Canal, the locks and gates, was published in *Engineering News-Record*, Sept. 4, 1930, p. 356. Construction of the canal was carried on by the Department of Railways and Canals, Dominion of Canada, of which A. E. Dubuc is chief engineer. Alex J. Grant is engineer-in-charge, and Frank E. Sterns is designing engineer. Contract for the construction of the pontoon crane from Wellman designs was placed with the Collingwood Shipyards, Ltd., of Collingwood, Ont., who in turn let contracts for the hoisting machinery to the Canadian Allis-Chalmers Co. and for the electrical machinery to the Canadian Westinghouse Co., Ltd.

Steel-Frame Houses With Poured Light-Weight Concrete Walls

THE ERECTION of a two-story building 26 to 32 ft. in plan at the North Arlington, N. J., plant of the Porete Manufacturing Co., in which a steel frame is inclosed in poured light-weight concrete, records a new development in the field of steel-frame house construction.

The steel frame used in this building, which houses the offices of the company, is unusually light. A system of twelve wall columns is used, the four corner columns being 4x4x¼-in. angles, and the six intermediate columns consisting of two 2½x2½x¼-in. angles. In addition, there are two 4-in. H-columns in the center of the building. Diagonal bracing of light wiring is used. The wall columns are tied together by 7-in. channels and I-beams, and 4-in. filler beams are used in the floors and roof. On the floors the filler beams are welded. This frame leaves large openings in the walls, providing flexibility for window installation. The cost of all the steel furnished and erected amounted to $742.

The thickness of the steel members in the wall is 4 in. and less. Thus, a 1-in. fill protection on each side determined a 6-in. thickness for the wall. Similar conditions fixed the thickness of the floor and roof at 6 in. Wood forms 4 ft. 10 in. high were built and raised four times in pouring the walls, including the parapet. The light-weight concrete used for the walls, floors and roof is a product of the company. In its manufacture portland cement and sand in the proportion of 1:1 are beaten up in a special mixer, with about 2 lb. of a foam compound per cubic yard. In this mixer air is beaten into the concrete so as to produce a mixture in which the sand and cement are held in suspension by small air bubbles. The mixing time for a 1-cu.yd. batch is 5 min. The final weight of the material when set is 45 lb. per cubic foot. The day after the first floor was poured, a 1-in. thickness of 1:3 cement and sand was applied on top. On the roof a five-ply pitch covering was placed directly on top of the fill. As the final step on the outside, two coats of cement stucco, with a total thickness of ¾ in., were applied. On the inside two coats of plaster and lime finish ¾ in. thick were applied directly to the walls, which, when completed, had a total thickness of 7½ in. The cost of the completed building, including electric light and telephone wiring, plumbing, heating, partitions and painting, was about $7,500.

Small office building with steel frame and walls. Floors and roof are of poured light-weight concrete.

Floodlighting Construction Work for Night Operations

Proper and adequate illumination necessary for safety and economy of night work—Two systems, distributed and centralized, are in general use

By H. E. Mahan
Engineering Laboratory, General Electric Co., Schenectady, N. Y.

CONSTRUCTION operations during the period of darkness are frequently advantageous from an economic standpoint and often imperative during emergencies. Under such circumstances artificial illumination is required and the manner of providing it becomes of interest to the contractor. The amount of illumination and its distribution are of utmost importance in planning a floodlighting system. The cost of a proper illumination system is often saved many times over in elimination of accidents, increased efficiency of workmen, easier operation of equipment and prevention of thievery on the job.

Two systems in use

There are two general methods of providing light for construction operations, the distributed system and the centralized system. In the former, reflectored light sources are placed over active areas and temporary wiring is strung to convey power to them. As the construction work progresses the light sources and wiring are changed to new locations. The centralized system utilizes floodlighting projectors and contemplates a more or less permanent location for the light sources at locations convenient to the source of power and the projection of the light to the active areas as required. In this way the time and labor of changing the wiring is minimized.

The floodlighting projector is available in many forms, offering a type of mechanical construction, range of wattage and character of light distribution sufficiently varied to meet the demands of the service in which they are to be used. The wattage range of these projectors is from 200 to 1,500 watts; the beam spread from 12 to 90 deg.

Because of the many varying types of construction work, it is difficult to establish rules relating to the quantity of light required and the necessary power load. These items depend upon the character of the work and the nature of the structures embraced in the operation. It is desirable to make a survey of conditions on the ground before making a definite lighting layout. For purposes of estimate an approximate determination of power requirements may be obtained by allowing 0.25 to 0.50 watt per square foot of ground area. This estimate applies to open work and is not intended to cover, for example, floor operations in an office building.

The cost of adequately lighting a construction operation is returned manyfold by the increased efficiency of the workmen, the greater safety afforded and the ease with which the job may be policed. It requires only the saving of a few minutes' time of each workman to cover the cost of lighting, and the avoidance of only one accident will probably defray the entire cost of the installation. This last item is of utmost importance, for studies have shown that for every dollar actually paid for compensation four dollars are spent by the contractor for indirect costs of accidents.

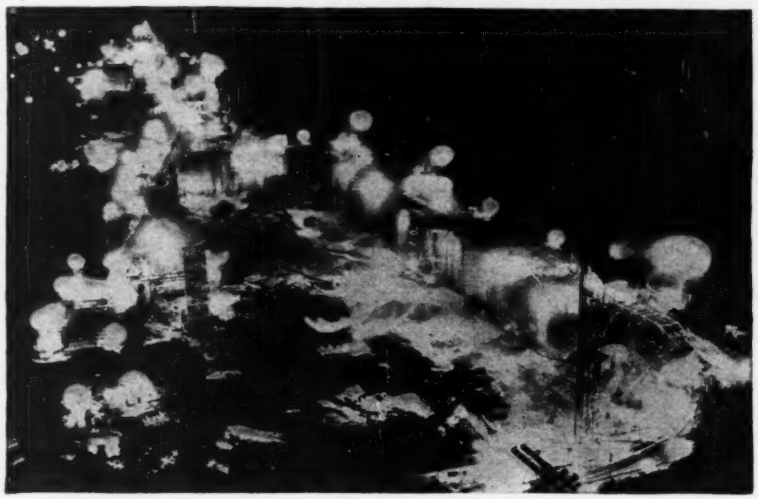
The greater efficiency of workers when provided with adequate illumination has been conclusively established in industry, and a vast amount of data has been accumulated relating to illumination intensity and rate of production. Investigations disclose a 10 to 25 per cent increase in production resulting from an increase of illumination from 3 foot-candles to 12 to 15 foot-candles. The cost of providing this increased illumination has represented a cost equivalent to from 0.5 to 2 per cent of the payroll expense. Comparing this additional expense for the improved lighting with the value of the increased production shows the investment in lighting to be very profitable.

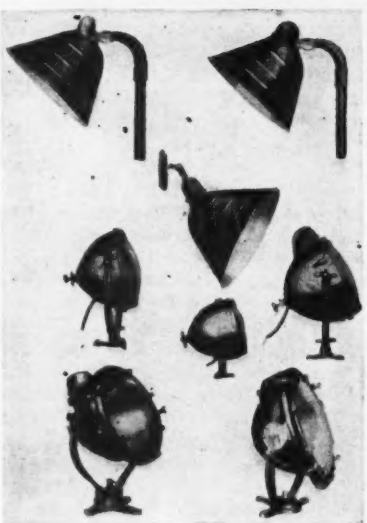
In construction work, night operations are very frequently a profitable policy, as there are fewer disturbing influences to retard progress. This is particularly true where traffic conditions are a factor to be considered. During emergency operations running into night work the value of proper illumination is increased, for the workmen usually receive high overtime wages.

Proper illumination also makes it advantageous often to double-shift the job to bring it to earlier completion, to take advantage of favorable weather, to cut down general overhead charges, to reduce plant charges on the heavy equipment investment.

The loss due to the theft of equipment and materials from construction operations is frequently quite an item and practical measures for minimizing this loss are constantly being sought. Illumination throws a mantle of protection around such areas, serving both to discourage the activities of the thief and to enable responsible persons to detect readily any acts of depredation.

Night construction at Bagnell Dam—An excellent example of proper illumination.





Types of open and closed floodlight projectors for construction work. Lamps from 200 watts to 1,500 watts may be used with these projectors.

Concrete-Arch Memorial Bridge at Aurora, Ill.

Nine four-rib open-spandrel arches with abutment piers in the river and girder shore spans—Retaining walls with T-heads carry sidewalks on approaches

ARCHITECTURAL and sculptural treatment of a concrete-arch bridge design, in order to produce a structure worthy of being a war memorial, has been attempted in the new Fox River bridge at Aurora, Ill., which was opened on Nov. 11, 1931. Lowered construction costs during the period between the approval of the bond issue and the letting of the contract enabled the city to provide funds for this elaboration of the original design. A general view is shown in Fig. 2. (See also *ENR* of Nov. 12, 1931, p. 786.)

Old Wrought-Iron Bridge — A wrought-iron bridge on stone piers, built in 1883 to connect New York and Walnut Sts., had four through-truss spans of 175 ft. Its roadway had a clear width of only 20 ft., and with the heavy traffic of recent years the truss members were struck occasionally by motor trucks and automobiles, necessitating emergency repairs. But the amount of traffic precluded any narrowing of the roadway by guards that would keep all vehicles clear of the trusses.

This condition was the main reason for the replacement of the old bridge, for while the spans were somewhat light for modern loading, the material was in good condition, with very little corrosion, even at points where dirt collected and held moisture. After its removal, in 1930, the old piers were cut down to the level of the riverbed.

New Concrete-Arch Bridge — The new bridge is a reinforced-concrete structure, with nine arch spans of the open-spandrel type, 66 ft. c. to c. of piers, flanked at each end by a concrete-cased steel-girder span, with a short approach fill between retaining walls. Thus the arch thrust is taken by abutment piers instead of by solid abutments. These piers are in the river, outside of the shore line, and are made distinctive by heavy pylons (Fig. 2), which are carried up above the bridge deck. The bridge is designed for the H-20 loading provided in the specifications of the American Association of State Highway Officials, but with a further provision for a future double-track electric railway carrying 40-ton cars, while the sidewalks are designed for a uniform load of 125 lb. per sq.ft.

A city bond issue of $350,000 was approved in 1929, but definite plans were delayed by uncertainty as to the location of the east abutment. The Chicago, Aurora & Elgin Railway, an electric interurban line that ran formerly through one of the main streets, had purchased property for a relocation along the river bank to a new terminal station at New York St., adjacent to the bridge site. For this purpose it desired to fill in 40 ft. beyond the shore line, but as this was opposed by the War Department and some local interests, a permit for the bridge could not be obtained from the War Department. Finally, the matter was settled by approval of a 28-ft. width of fill to a new shore line, after which the bridge permit was issued.

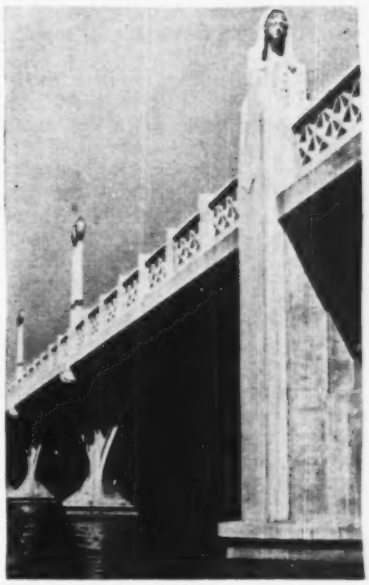
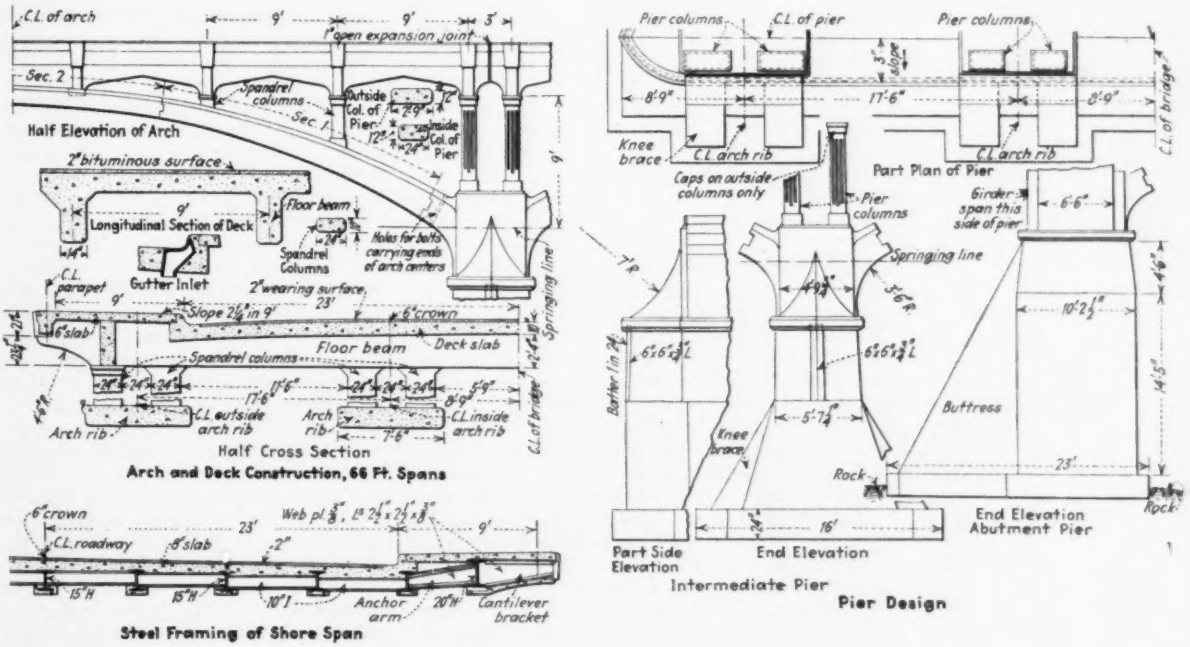


Fig. 2—Monumental abutment pier of new Fox River bridge at Aurora, Ill.

Fig. 1—Arch and deck construction and pier design details, Fox River bridge.



An interesting feature proposed, but not carried out, was a lateral approach to the middle of the bridge from an island just below it. This island, which is a part of the business district, has bridges on each side and a longitudinal street that was intended to extend to the bridge by a short concrete-girder approach viaduct. Opposition was made on the ground that such a structure could not be construed as an "approach" and therefore could not be paid for from the bond issue for "bridge and approaches." After some heated controversy this proposed connection was abandoned.

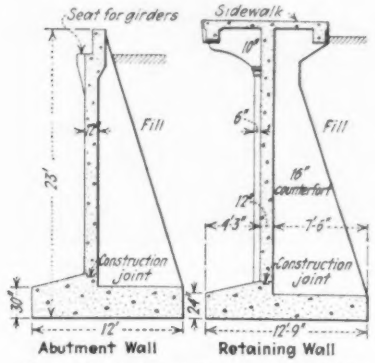


Fig. 3—Walls for filled approaches. Note T-head retaining walls forming sidewalks.

Piers and Foundations—Pier foundation conditions were favorable, bedrock being found at depths of 8 to 18 ft. below water level. This was excavated for about 12 in. to provide an even bearing in solid rock. The overburden of gravel and mud is 5 to 15 ft. thick. A depth of 2 to 5 ft. of water is maintained by a dam at the head of the island already mentioned. Wood piling was used under the retaining walls and abutment wall of the west approach, where the rock is 14 ft. below the footings. Typical plans of the end, or abutment, piers and the intermediate piers are shown in Fig. 1.

Piers 5½ ft. thick and 68 ft. long extend only about 18 in. above normal water level. The two abutment piers have their footings extended on the land side to support four heavy buttresses in line with the arch ribs, to take the end thrust. The other piers have four knee-braces on each side, in line with the ribs, to distribute the thrust over the footings and also to insure against any rocking or rotation of the piers. At the rounded ends of the piers the nose is faced with an angle or bent plate 6x6 in., secured by anchor straps, in order to protect the concrete from floating ice.

In the design it has been the aim to make the abutments significant features of the bridge ends. It was felt that with abutments at the shore lines, buildings erected at the street front and adjacent to the bridge would mask or spoil the effectiveness of such entrance treatment. To avoid this objection, the arch abutment piers were placed in the river, with their center lines 36 ft. from shore, each being flanked by a girder span connecting to an abutment wall on the bridge approach. The abutment piers were then made significant by pylons carried up high above the level of the bridge.

Arch Spans—All the arches are 66 ft. c. to c. of piers, with 63¼-ft. clear openings and a rise of 9 ft. above the springing lines. Their construction is shown in Fig. 1. The arch curve was derived from the equations of Strassner, as adapted from the German by the designer. Each span is composed of four ribs 7½ ft. wide and 15 to 28 in. deep, each rib carrying two rows of spandrel columns. Upon these columns are transverse girders or floor beams 9 ft. apart and cantilevered about 5 ft. beyond the outer rows of columns. Double sets of spandrel columns are used at the piers, as the deck slab is not continuous but is interrupted by an expansion joint over each pier.

In the expansion joints, sliding connections are eliminated wherever possible. Over each pier a 1-in. space is provided between the adjacent roadway slabs, sidewalks and parapets. On the parapets this joint is left as a clear opening. On the sidewalks it is filled with a bituminous filler. In the roadway the joint is covered with a steel plate, over which the 2-in. wearing surface is laid as a continuous sheet.

The tops of the floor beams are cambered to the contour of the 10-in. deck slab for the roadway, which is 46 ft. wide between curbs, with a 2-in. bituminous paving, except at the gutters, where a 2-in. shoulder is formed to retain the roadway paving. Sidewalks have a clear width of 9 ft. inside the parapet walls, but the 6-in. slabs are about 10 ft. wide, giving a total over-all width of 66 ft. for the bridge. Between the spandrel columns of the outside rows are arched spandrel beams, forming two lines of longitudinal beams or struts between the transverse floor beams. The roadway rises from each side on a grade of 0.5 per cent to a central parabolic vertical curve 500 ft. in length, giving a maximum height of 13 ft. 9 in. above water at the central span.

Approaches—With the arch abutment piers placed in the river, a 33-ft. flanking span was provided at each end, to connect with the shore abutment and approach. Flat steel spans (Fig. 1) were adopted in order to make the series of arches more significant than if small approach arches had been introduced. Each steel span consists of 15-in. H-beams laid longitudinally and connected by transverse struts of 10 in. I-beams framed between them. These struts are at different elevations on the webs of the H-beams to allow for the camber of the 8-in. concrete deck slab. For each sidewalk there is a single 20-in. H-beam with 5-ft. cantilever brackets attached to its outer side, while on the inner side are corresponding anchor arms attached to the sidewalk beam and the adjacent 15-in. H-beam at the curb. All structural steel is incased with concrete.

Walls of counterfort type are used for the abutment wall of each steel span and for the retaining walls of the short filled approaches, as shown in Fig. 3. These retaining walls, however, are of curious design, being T-shaped in section, with a T-head 13 ft. wide forming the sidewalk slab, which is stiffened by a fascia

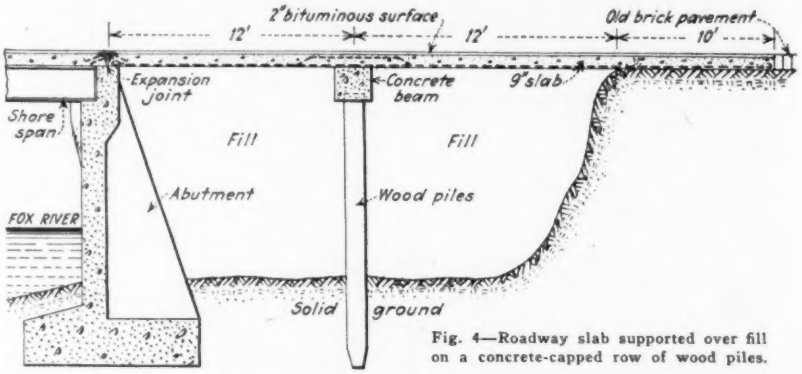


Fig. 4—Roadway slab supported over fill on a concrete-capped row of wood piles.

girder and a curb. Upon this is built the concrete parapet. Cantilever brackets on each side support the slab. The object of this design was to prevent the usual settlement of sidewalks when built on a fill. While the roadway is built on the fill, special construction was provided to insure against its settlement at the bridge ends. Behind the abutment walls a transverse row of wood piles (two rows at the east end) was driven (Fig. 4) and was capped by a transverse concrete beam 20 in. wide and 26 in. deep. This beam supports the roadway slab, which extends from the abutment wall to the solid ground beyond the fill.

Decorative Treatment—Originally the bridge was designed of rather plain appearance; and to cover the original estimate, the bond issue, approved in 1929, was for $350,000. But prices dropped materially while the controversies already noted were being settled; and in May, 1930, the contract was let for $273,000, which did not in-

clude the approaches. As the contract price was so much below the amount of the bond issue, a movement was started to elaborate the design and make a structure architecturally suitable as a memorial to the local men who had served or died in the nation's wars. When this plan received public approval, competitive designs were asked from several sculptors and architects.

The adopted design included surmounting the four pylons of the arch abutment piers with figures representing Memory (Fig. 2), placing a bronze figure of Victory at the center of the bridge, using a more decorative form of parapet, mounting the electric-light standards in pairs as a distinctive feature, and introducing other minor decorative features. A pair of standards with the parapet wall and its open expansion joint is shown in Fig. 5. For the Victory statue a semicircular balcony was provided on the north side at the center of the middle span, where it would face the viaduct approach from the island, already mentioned. With the abandonment of this approach, it was necessary to balance the design by a similar balcony on the south side, and here a relief representing the several branches of the military service has been erected on a pedestal to face the statue. These balconies are supported by steel beams incased in concrete. The beams extend over the full width of the structure and serve as floor beams as well as cantilever extensions to carry the balconies. The parapet panels were all cast in place, as were the four figures on the pylons.

For the surface finish the forms were removed in about 36 to 48 hours after pouring, and the concrete was wetted and ground. Carborundum wheels were used at first, but as these were found to have a tendency to pull out fragments of the aggregate they were replaced with sandstone grinding wheels. After the first grinding the paste thus produced was allowed to dry, after which it was again wetted for a final grinding and sluiced with water to leave a clean surface. Bevel-edged wheels were required for finishing the rather intricate parapet work. With the standstone grinding a very white color is given to the concrete.

Construction — Excavation for the piers was done by a crane with clamshell bucket and by hand. In the forms for the piers composite struts were used, consisting of wooden end pieces and precast reinforced-concrete struts, the latter remaining embedded in the mass concrete. This plan is said to have reduced the cost of the pier form work. Each arch was poured in three sections, the haunches first and then the central portion, these sections being united by dowel rods and a mortise joint. This arrangement was adopted in order to compensate for shrinkage and to relieve initial stress in the steel due to the setting of the concrete. Steel

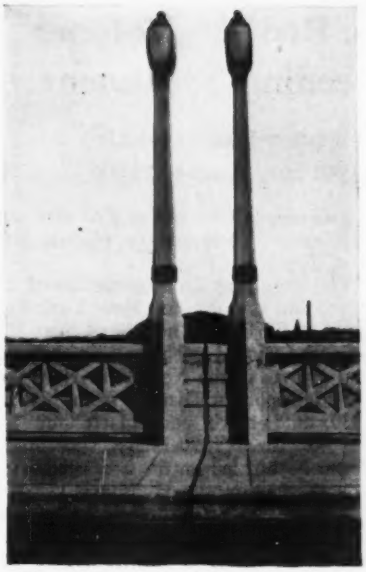


Fig. 5—Lamp standards and parapet. Expansion joint is open in parapet, filled in the sidewalk and covered by bituminous paving in the roadway.

trusses for the arch centers were suspended from the projecting stub ends or "umbrellas" of the arch ribs, which were built as parts of the piers. Diagonal bolts or rods through these umbrellas carried the seats for the trusses, as indicated in Fig. 1.

High-early-strength concrete was used for all work above the piers, the primary reason being to save time in construction and to reduce the cost of steel centering for the arches, since with such concrete the centers could be removed in three or four days and shifted to another span. The cost of extra cement for this concrete was about $4,000, an amount that was amply compensated for by the saving in time and the exceptionally good quality of the concrete. A mix of $1:1\frac{1}{4}:2\frac{1}{2}$ was proportioned by volume. On account of the reinforcement the mix was fairly wet, giving a slump of about 4 to 6 in., but the amount of water was measured mechanically for each batch and was not left to the judgment of the mixer operator. For the high-early-strength concrete the batch proportions were seven sacks of cement to 1,400 lb. of sand and 1,825 lb. of gravel, both the aggregates being weighed when wet.

For the piers and foundations the proportions were five sacks of cement to 1,350 lb. of sand and 1,825 lb. of gravel. In a richer mix for the parapet walls and the concrete figures on the pylons, crushed granite of $\frac{3}{4}$-in. maximum size was used for the coarse aggregate. Concrete was poured in place, mainly by chutes, with telescopic pipes or trunks for the foundation and pier work. Hand placing was required, however, for the parapet walls. In these walls the posts were poured first and served to support the forms for the panels. Wood forms were used throughout.

In casting the four pylon figures it was necessary to make two clay models and two plaster molds, for while they are identical in design the two pairs face opposite directions. The molds were made with wire lath, fiber and burlap, heavily braced with sand as backing to resist pressure. The concrete was then placed in two operations; a neat concrete made with sand only was applied to the face of the mold, and heavy concrete was then placed in the center and compacted so as to force the neat concrete into all the crevices of the mold, giving a smooth clean surface and sharp outlines.

Construction was started in May, 1930, and carried on during the following winter, the bridge being completed in July, 1931, except for decorative finish and the bronze statue and tablet. For the winter work steam pipes were used to heat the aggregate and the water was heated, so that concrete left the mixer at a temperature of about 84 deg. F. More than 500 control cylinders were made and tested, samples being taken every day. These cylinders were stored and cured on the work, so that when tested they would represent the actual condition of the concrete in corresponding parts of the structure. Thus, where concrete poured in cold weather was inclosed and kept warm by salamanders, the control cylinders from that concrete were stored in the inclosure. As these tests enabled the strength of concrete in particular parts of the structure to be determined at any time, the removal of forms was expedited materially.

Engineers and Contractors. The design for this bridge was prepared cooperatively by Walter E. Deuchler, city engineer, and the Engineering Service Co., of Aurora, Ill., with A. H. Sorenson as structural engineer of the company. The subsequent decorative treatment was designed by Emory P. Seidel, Chicago, who also modeled the concrete and bronze statuary. The John Ward Co., Aurora, had the general contract at $273,000. The total cost, including approaches and paving, was $335,000, of which the statuary and decorative work supplementing the original design represented about $30,000.

South Africa Using Steel Ties

About 6,000,000 steel ties are in use on the South African Government Railways, according to a report of the U. S. department of commerce, with nearly 5,000,000 purchased in the four years 1927-30. They are used with rails weighing 35, 45, 60 and 80 lb. per yard, all on tracks of $3\frac{1}{2}$ ft. gage. Their cost in 1930 averaged $1.54 and $2.34 each for track with 60- and 80-lb. rails respectively. All these ties were purchased in Europe, but a steel plant at Pretoria is expected to be in operation in 1933.

Population Overestimate Reduces Volume of New York Sewage Needing Treatment

Engineering committee of Merchants Association believes population will be not more than 10,250,000 in 1960 instead of 14,675,000

OVERESTIMATES of the population growth of New York City, and therefore of the volume of sewage needing treatment, the degree of treatment required and the cost of the necessary works are reasons given in a report made by a committee of the Merchants Association of New York City for modifying the tentative plans of the department of sanitation submitted to the city authorities early in 1931 but not yet acted upon. The committee believes that the population of the city in 1960 will be about 10,250,000 instead of the 14,675,000 estimated by the commission. The committee was headed by the late Olin H. Landreth. Among the other members of the committee were the following engineers: Nicholas S. Hill, Jr., Thaddeus Merriman, Andrew J. Prevost, Henry C. Turner, C. C. Vermeule and H. Burdett Cleveland. The two last-named and Prof. Earle B. Phelps were a subcommittee on data and findings.

Original proposals

The sanitation commission, which now has charge of sewage disposal, street cleaning and the collection of disposal of garbage, refuse and ashes in the five boroughs, presented three tentative plans, each covering the entire city, providing respectively 56, 79.1 and 92.4 per cent of "purification," designed to restore the waters receiving the sewage to the conditions (biochemical oxygen) demanded of 1925, 1905 and 1893. It recommended the middle plan, at a total estimated cost of $243,560,000 (*ENR*, June 16, 1931, p. 1,027). Each plan was based on a population of 14,675,000 in 1960 and a daily sewage flow of 2,117,000,000 gal. The plan proposed for adoption called for 33 plants, of which six would be of the activated-sludge type, twelve partly of that type and fifteen would provide for sedimentation. Among the activated-sludge plants was the large one now being built on Wards Island. The committee agrees with the commission that the medium-treatment plan should be the one adopted by the city, except for a 30 per cent reduction in capacity and cost, and that its revised estimate of population makes only 60 instead of 79.1 per cent purification necessary to restore 1905 conditions.

The argument for a reduction of the population estimate for New York City from 14,675,000 to not more than 10,247,000 is based on a study of population growth in the New York-New Jersey Metropolitan District from 1840 to 1930, and more particularly for the last 40 years (1890-1930), with attention concentrated on the areas tributary to both sides of the Hudson River, the latter being taken into account because, although not in the tentative plan for New York City, it contributes to the pollution of the river.

Population increase slower

From 1840 to 1930 the population increase of the entire Metropolitan District, including the New Jersey counties of Hudson, Essex, Union, Passaic and Bergen far enough north to include the city of Paterson and the borough of Englewood, declined from 76 per cent for the first to 23.7 per cent for the last of these nine decades, and that of New York City alone from 78.6 to 23.3 per cent. If the 90 years is divided into two periods of 50 and 40 years (1840-90 and 1890-1920), a striking change in growth increments by decades is shown. From 1840 to 1890 the average growth by decades was 25 per cent for the whole Metropolitan District and 23 per cent for New York City ("compounded," the report reads). Increments in terms of population for the last four decades are shown in the accompanying table.

Commenting on this table the report says:

> Taking into account the restriction of immigration and the decline of natural increase of population, the above figures afford little reason to expect that the rate of increase during the next three decades will be greater than the average increment shown in the table below, or 1,105,758 per decade for the city of New York. This would give us, for 1960, a population of 10,247,180, instead of the 14,675,000 upon which the plans submitted have been based. We believe that this will be sufficient to include both resident and transient population, and in this we are influenced by the following consideration.
>
> Dr. Louis I. Dublin has given strong reasons for a conclusion that the growth of the United States will entirely cease by 1970. The Metropolitan District has quite consistently absorbed 10 per cent of the increase of the entire United States, and it must be assumed that its growth will be greatly affected by the growth of the country as a whole. Should that growth cease by 1970, we estimate that the population of the city of New York, by 1960, will not exceed 8,589,083.
>
> We have made a further estimate on the assumption that the increment per decade will not entirely cease but will fall to 4 per cent of the population between 1960 and 1970. On this assumption we reach a population for 1960 of 8,848,241.
>
> It will be appreciated that it will be much more conservative to assume a population such as we have above estimated, not to exceed 10,247,180, than to build for a population more than 40 per cent greater, which may never be reached.

As to the degree of purification required to restore the waters around New York City to their condition in 1905, which, in the sanitation commission's tentative plan, was put at 79.1 per cent on the basis of 14,675,000 population in 1960, the Merchants Association's committee reduces the figure to 60 per cent, on the assumption that the 1905 population was midway between that of 1900 and 1910, or 4,102,042, and that the 1960 population will be 10,247,180 instead of 14,675,000, as estimated by the commission.

Sedimentation for Hudson sewage

The committee states that the population tributary to the Hudson River, including the westerly part of Manhattan Island, the city of Yonkers and the easterly part of Hudson County, N. J., showed a population shrinkage from 1920 to 1930 of 12.1 per cent (2,932,440 to 2,577,486). This it sees as an argument in support of plan A (recommended by the sanitation commission and endorsed by the Merchants Association's committee), which provides for sedimentation for the Hudson drainage area of New York City, whereas plan B calls for a long outlet sewer to "Outlet Island" (off Coney Island) and partial activated-sludge treatment there. That a high degree of treatment is demanded for sewage tributary to the East and Harlem Rivers and Long Island Sound is indicated, the committee says, by a 50 per cent increase in population in the last census decade.

INCREMENTS, IN TERMS OF POPULATION, FOR THE LAST FOUR DECADES

	New York Portion	New Jersey Portion	Whole District
1890-1900	929,788	298,955	1,228,743
1900-10	1,329,681	441,170	1,770,851
1910-20	853,165	367,782	1,220,947
1920-30	1,310,398	453,022	1,763,420
Average Increment Per Decade			
1890-1930	1,105,758	390,232	1,495,990
Comparison of 20-Year Increments			
1890-1910	2,259,469	740,125	2,999,594
1910-1930	2,163,563	820,804	2,984,367
Change, per cent	—4.24	+10.9	—0.5

Reclamation Yields Large Returns in Revenue

Crops valued at $120,000,000 were produced on federal reclamation projects in 1930, according to the recently published annual report of the U. S. commissioner of reclamation. Despite a reduction in total value of 26 per cent as compared with 1929, the crops amounted to nearly $3,000 per farm (40,354 irrigated farms), or $740 per capita of farm population. Referred to area, it was about $43 per irrigated acre. As the expenditures of the bureau since the beginning of federal reclamation in 1902 amount to $263,400,000, the crops of the single year 1930 represent 46 per cent of this total.

Jack-Knife Draws Originated Nearly 100 Years Ago

New England type of swing bridge now abandoned was developed by Joseph Ross about 1845 for Eastern Railroad—Some plans of its later adaptation to modern loads

By J. P. Snow

Consulting Engineer, Boston; Formerly Bridge Engineer, Boston & Maine Railroad

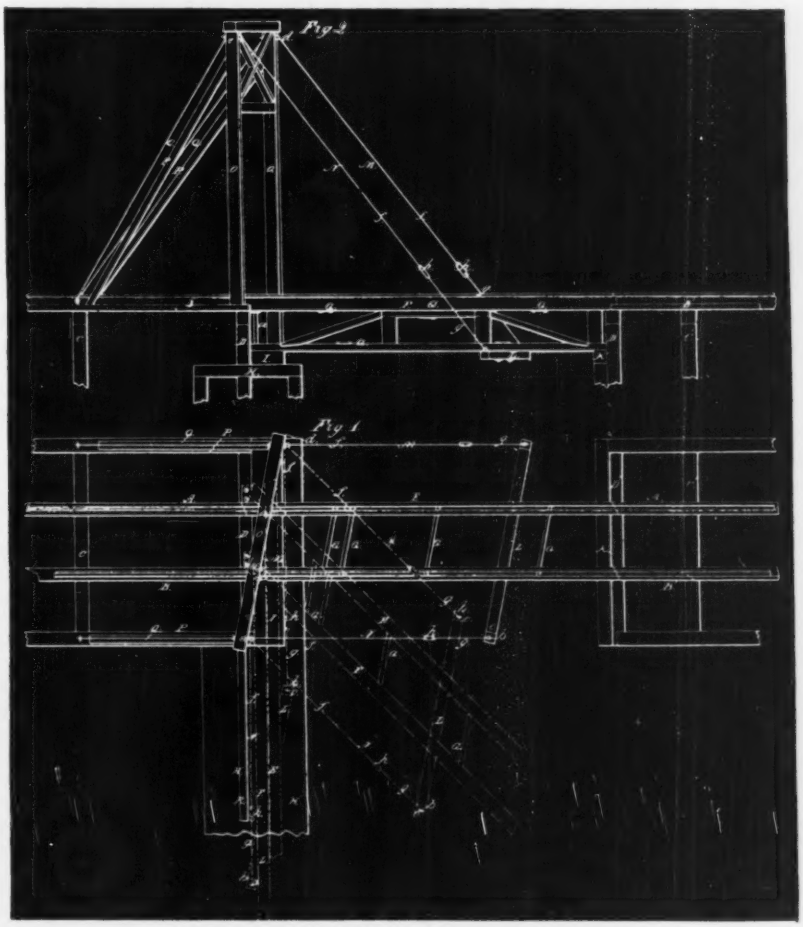
AN EDITORIAL in *Engineering News-Record* of Nov. 5, 1931, entitled "Engineering Antiques," contains remarks on the passing of jack-knife drawbridges that suggest the timeliness of a brief history of the origin of these curious structures and their subsequent development as rolling equipment increased in weight, and timber of adequate size and quality became rare and expensive.

The editorial implied erroneously that the 1835 bridge of the Boston & Lowell Railroad crossing the Charles River at Boston was of the jack-knife type. That bridge was a swing shear-frame draw, many of which were built for light rolling stock and narrow openings. Such a draw swings as a whole on a heel-pin at the center of the track, the free end being raised by a transverse needle-beam long enough so that its guy cables will allow side clearance for cars, the cables being brought together at the head of the A-frame shear, which must be vertically over the heel-pin. The A-frame is hauled backward to raise the free end of the bridge from its bearings, and the bridge is swung by a pinion geared with a rack on a timber arm hinged to the side of the bridge. The guy cables are held apart by a spreader at a height to give vertical clearance to trains. This type is confined to single track and is troublesome in some locations.

In 1849 Joseph Ross (1822-1903), of Ipswich, obtained a patent entitled "J. Ross patent swing bridge." The illustration is from a photostat print of the patent drawing. The only appliance for raising the free ends of the trusses seems to be the turnbuckles in the guys, and no way is shown for swinging the trusses. Mr. Ross was a successful general contractor for earthwork, masonry and timber construction. In company with Josiah Shaw, a noted framer of timberwork, he built many bridges of this type, which soon came to be called the jack-knife draw, for railroads across navigable estuaries along the coast of New England. Frank B. Rowell, research engineer on the Boston & Maine Railroad, says that John Glazier, who in his early years sailed as "Chips" on Salem ships in the China trade and later became a foreman bridge carpenter on the Eastern Railroad, told him that Joseph Ross and Samuel Ashburner, a draftsman with the engineer corps engaged in building the Eastern Railroad, got their heads together and designed a drawbridge to cross the inlet to the harbor at Manchester, Mass., on the Gloucester branch of that line. They evolved the type shown by the illustration, Ross probably doing the planning and Ashburner making the drawing. The Manchester bridge was built in 1845, but Mr. Ross did not obtain the patent till 1849, as he probably wished to try it out in service before advertising too much.

The later development of this type is nicely shown by the two views of the Charles River bridge shown Nov. 5 (p. 719). Eight tracks were there handled by two bridges, one turning off to the right and one to the left. Four tracks were accommodated by each tower, there being eight trusses, and four needle-beams, with eight guys and sets of levers. The face of towers and the hinge-pin line must make an angle with the channel sufficient to allow the trusses to lie side by side when swung off to open the waterway.

The description given with the illustrations is faulty in some respects. The underhung beams that carry the free ends of the trusses when swinging are properly called "needle-beams," and the guy cables are attached at the top to the short ends of forged levers by link and shackle that act as hinges when the bridge swings. These levers are hung in heavy cast-iron trunnion supports and in heavy bridges are actuated by steam or other power. The swinging arm is also operated by power. In early days, for single track, a plain beam was adequate for the needle-beam, and hand windlasses were sufficient for operating



Facsimile of Joseph Ross original patent drawing of 1849 of the jack-knife bridge. A bridge of this type was built at Manchester, Mass., four years earlier. Mr. Snow suggests that Ross wanted to try out the bridge before patenting his invention.

the levers; but for two tracks and heavier trusses a pair of needle-beams, placed far enough apart so as to come nearly in contact when swung off, and compound levers for raising the trusses were required.

Previous to 1890 or thereabouts, the needle-beams were made of timbers strengthened with rugged queen-post belly-rods, but in renewals in 1892 iron box-girders were used on one of the Charles River bridges, although they were submerged twice each day by the tides. Howe trusses were used up to that time, and the towers were built of timber. A comparison of the tower shown on the patent drawing with those on p. 719 will disclose the growth due to heavier loads in less than a half century. In 1893 the bridge over Miller's River at the northerly end of the Boston yard (bridge 2 of the article mentioned) was built to accommodate four tracks, and as time was limited the trusses, towers and needle-beams were built wholly of iron.

Engine loads increased so that in 1909 and 1910 the Howe trusses of the Charles River bridges were replaced with steel trusses. Around 1910, when jack-knife draws on outlying lines of the Boston & Maine Railroad required rebuilding on account of double-tracking or other cause, they were replaced by bascule bridges. Because of increasing engine weights and to shorten the time of opening and closing, this practice has since been continued. Until about 1890 these bridges were operated by hand power, both for hoisting the free ends of trusses and for swinging off and on, but after that date power was applied on account of increased weight and the need of quicker operation.

In a brief description of jack-knife drawbridges in Merriman's handbook the following comment is made: "Since jack-knife draws cannot have floors, such bridges should not be used." The statement implies that these bridges lack something, probably safety, from their lack of continuous floors; but the writer's long acquaintance with them has failed to prove this to be just.

Estimating Field-Welding on Multi-Story Buildings

Units of time and materials derived from experience on three of the largest buildings presented for use of designers and estimators

By Frank P. McKibben
Consulting Engineer, Black Gap, Pa.

THE COMPLETION of several welded buildings of substantial size has made available a considerable amount of production data that should prove useful when considering future projects. The information in the accompanying tables is presented with the hope that the path of some designer or estimator may be made easier. That he must carefully consider the applicability of the figures to his immediate problem is strongly emphasized by marked variations in any one class of values for the three buildings considered. Why, for example, should only 41.5 lin.in. of fillets be necessary to field-weld a ton of steel in Wilmington, Del., while in Boston 46.05 and in Dallas 63.5 lin.in. are used to produce the same result? These differences mark clearly the importance of knowing the applicability of the data before using them.

A provision of the leases of lands on which the Boston office building stands, necessitating the structure to be designed for "any commercial use allowed by the zoning law," required an unusually heavy live load of 125 lb. per square foot of floor area to be used in design, whereas in Wilmington and Dallas lesser load provisions were used. These differences affect the total amount of welding in the building, as well as the steel tonnages, but not in equal ratios. Although for floor-beam and girder connections the linear inches of fillet welds vary as do the loads, and therefore somewhat as the steel tonnages, this is not true of column splices or of connections of girders to columns to resist wind-bending moments.

Moreover, whereas the Boston building code requires all field connections of secondary as well as main floor beams to be riveted (or, in the Boston building, to be welded), most other cities, including Wilmington and Dallas, permit connections of secondary beams to be permanently field-bolted. In Boston this results in a greater amount of welding per ton of steel in the building. Field connections of secondary beams in the Wilmington building were permanently bolted. The Dallas structure has almost no secondary beams, and practically all connections were welded.

Furthermore, the size, shape and location of the Wilmington building rendered unnecessary any provisions in the steel frame for resisting wind stresses. In Dallas the main-floor girder beams had their connections to columns heavily welded to transmit wind moments in two directions at right angles to each other; and in Boston such provisions were made in one direction only. The Boston and Wilmington buildings were shop-riveted and field-welded. The Dallas structure was completely shop- and field-welded except for three plate girders that were shop-riveted.

It should be noted that ½-in. fillet welds were used for 17,842 lin.in. of field-welding in the Dallas building, which required two passes instead of one. And the average of 39.2 in. of fillets deposited per man per hour in the shop included work done in qualifying a considerable number of welders.

The variables outlined above are sufficient reasons for variations in the units presented; all of which emphasizes the importance of applying empirical data with care.

In discussions it is important to have clear definitions of terms used. Interpretation of the tables shown herewith is no exception to the rule. When one speaks of the number of linear inches of fillets per ton of steel, one must know the sizes of fillets, whether ⅜- or ½-in., and whether a ton of steel refers to a ton of steel in the building or a ton of steel field-welded at the building site. Thus, in Boston the total tonnage of steel in the building is 1,314, but the tonnage field-welded is only 1,050, the difference comprising steel in foundation cantilever beams and grillages devoid of welding. It is not always possible to ascertain these differences, but they should be given wherever available.

Another element of uncertainty lies in the difference between: (a) the amount of electrode actually melted to form the welds, (b) that purchased, and (c) that melted and wasted for the project. A certain number of pounds of welding wire are purchased and taken to the building site. What becomes of it? A part is actually melted in welding; a second part is wasted in "stub ends," which are the short unused pieces, from 2 in. in length up, dropped by the welder when the wire becomes too short to hold and to use; a third part of the wire purchased may not be used at all. The latter amount should be ascertained and of course deducted from the total to secure the amount wasted and actually melted in productive effort. In welding one building all wasted stub ends were retained and their total weight ascertained. Usually this is not done. But when done it leads to a study of the lengths of these wasted stubs and tends to reduce waste. There is no excuse for throwing away 6-in. stubs when they may be used till only perhaps 2 in. in length. In Tables I and II, where the electrode melted is

given as a percentage of that used and wasted, the assumptions are based on observations and not necessarily on actual weights. At all events, the terms electrode purchased, electrode used, electrode melted and wasted may mean very different amounts.

Consider now the uses to which Table I may be put. Assuming a building with a total of 2,500 tons of steel similar to that at Boston, a preliminary estimate of the following items may be made for field-welding:

1. Electrode melted and wasted	(2,500 × 1.98)	= 4,950 lb.
2. Welders' total time	(2,500 × .917)	= 2,292.5 man-hrs.
3. Total length of fillets	(2,500 × 46.05)	= 115,125 in.
4. Electric current used	(2,500 × 4.66)	= 11,650 kw.-hr.
5. Number of welding-machine-months to field-weld 2,500 tons	2,500 ÷ 140	= 17.9
6. Number of welding machines required to field-weld in approximately four months	17.9 ÷ 4	= 5
7. Number of welding machines required to field-weld in approximately three months	17.9 ÷ 3	= 6

The electric energy used includes that consumed in the actual productive effort of welding and that wasted while the machines are running idle.

The values for welding-machine-months given in the tables are all based on an eight-hour day.

In Table I, for the Boston building, the value of item 32, giving 140 tons of steel welded per machine per month, is based on the steel tonnage actually welded and excludes the 264 tons in foundations on which no welding was performed. If this be included, the steel per machine per month is then 1,314/7.5, or 175 tons. In the above estimate for number of welding-machine-months required to field-weld 2,500 tons in the hypothetical case, the result 17.9 was obtained by using the 140 tons. The use of 175 instead of 140 gives 2,500/175, or 14.3 welding-machine-months, as compared with 17.9 given; and 5 machines, instead of 6, would be required to do the work in 3 months.

A welding machine can produce much more welding than indicated in the tables, if welders could work continuously and were not required to consume time in moving about from connection to connection, as must necessarily be the case in multi-story buildings. The figures given are a fair indication of what can be accomplished under ordinary building conditions.

It is interesting to compare the number of linear inches deposited per machine per month—8,069 for Boston, 8,160 for Dallas and 8,175 for Wilmington.

In the above illustrative problem and in Tables I, II and III the welding hours include the time of welders only, exclusive of other time required in connection with work of this kind. Additional items of cost, such as supervision, layout of welds, necessary lost time, connection and maintenance of equipment, are necessarily a part of the whole and must be taken into account.

TABLE I.—FIELD-WELDING ON FOURTEEN-STORY BUILDING OF EDISON ELECTRIC ILLUMINATING CO., BOSTON, MASS.

Item	
1. Electrode (lb.) melted and wasted $\frac{1}{32}$ in.—1,500 lb., $\frac{3}{16}$ in.—1,100 lb.	2,600
2. Electrode (lb.) melted (assumed 80 per cent of total)	2,080
3. Current used, kw.-hr.	6,120
4. Total tonnage of structural steel	1,314
5. Structural steel welded, tons	1,050
6. Actual man-hours of welders' time	1,205½
7. Total length (lin.-in.) of $\frac{3}{16}$-in. fillets	51,921
8. Total length (lin.-in.) of $\frac{1}{4}$-in. fillet	7,188
9. Total length (lin.-in.) of $\frac{5}{16}$-in. fillets	1,405
10. Total length (lin.-in.) of all fillets	60,514
11. Fillet (in.) per ton of steel in building 60514/1314	46.05
12. Fillet (in.) per ton of steel welded 60514/1050	57.63
13. Fillet (in.) deposited per welding man-hour 60514/1205.5	50.2
14. Fillet (ft.) deposited per man per 8-hr. day	33.5
15. Fillet (in.) deposited per lb. electrode used and wasted 60514/2600	23.27
16. Fillet (in.) deposited per lb. of electrode melted 60514/2080	29.09
17. Fillet (in.) deposited per kw.-hr. 60514/6120	9.9
18. Electrode (lb.) melted per kw.-hr. 2080/6120	0.34
19. Current (kw.-hr.) to melt 1 lb. of electrode, 6120/2080	2.94
20. Welding man-hours per ton of steel in building, 1205.5/1314	0.917
21. Welding man-hours per ton of steel welded, 1205/1050	1.148
22. Electrode (lb.) melted per ton of steel in building, 2080/1314	1.582
23. Electrode (lb.) melted per ton of steel welded, 2080/1050	1.98
24. Electrode (lb.) melted and wasted per ton of steel in building, 2600/1314	1.98
25. Electrode (lb.) melted and wasted per ton of steel welded, 2600/1050	2.48
26. Electrode (lb.) melted and wasted per hour per welder, 2600/1205.5	2.16
27. Electrode (lb.) melted and wasted per lin.-in. of fillet, 2600/60514	0.043
28. Electrode (lb.) melted per lin.-in. of fillet, 2080/60514	0.0343
29. Current (kw.-hr.) per ton of steel in building, 6120/1314	4.66
30. Current (kw.-hr.) per ton of steel welded, 6120/1050	5.83
31. Welding-machine-months	7.5
32. Steel welded per month per machine (tons) 1050/7.5	140.0
33. Fillets (lin.-in.) ($\frac{1}{8}$-, $\frac{1}{4}$-, $\frac{5}{16}$-in.) per machine per month, 60514/7.5	8,069
34. Four welding machines and four welders	
35. Erection started April 9, 1930	
36. Welding started April 28, 1930	
37. Erection completed June 26, 1930	
38. Welding completed June 27, 1930	
39. Height, 187 ft.; width, 58 ft.; depth, 110 ft.	

TABLE II.—SHOP AND FIELD-WELDING ON NINETEEN-STORY BUILDING OF DALLAS POWER AND LIGHT CO., DALLAS, TEX.

Item	*Shop*	*Field*
1. Electrode melted and wasted (lb.)	7,100	4,650
2. Electrode melted (assumed 70 per cent of total)	4,970	3,255
3. Current used, kw.-hr.	No record	9,460
4. Total steel welded, tons	1,215*	1,170*
5. Actual hours of welders' time, man-hours	3,140	1,767½
6. Total length of $\frac{3}{16}$-in. fillets, lin.-in.	97,500	56,415
7. Total length of $\frac{1}{4}$-in. fillets, lin.-in.	25,400	17,842
8. Total length of all fillets, lin.-in.	122,900	74,257
9. Fillet per ton of steel, in.	101.2	63.5
10. Fillet deposited per welding man-hour, in.	39.2	42.0
11. Fillet deposited per man per 8-hour day, ft.	26.0	28.0
12. Fillet deposited per lb. of electrode melted and wasted, in.	17.3	16.0
13. Fillet deposited per lb. of electrode melted, in.	24.7	22.8
14. Fillet deposited per kw.-hr., in.		7.9
15. Electrode melted per kw.-hr., lb.		0.34
16. Current required to melt 1 lb. of electrode, kw.-hr.		2.90
17. Welding man-hour per ton of steel	2.58	1.51
18. Electrode melted and wasted per ton of steel, lb.	5.84	3.98
19. Electrode melted per ton of steel, lb.	4.08	2.78
20. Electrode melted per hour per welder, lb.	1.58	1.84
21. Electrode melted per lin.-in. of fillet, lb.	0.04	0.044
22. Current required per ton of steel, kw.-hr.		8.09
23. In field, welding-machine-months		9.1
24. Steel field-welded per machine per month 1170/9.1, tons		128.6
25. Fillets (lin.-in.) in field ($\frac{1}{8}$- and $\frac{1}{4}$-in.) per machine per month 74257/9.1		8,160
26. In field, five welding machines and five welders		
27. Erection started July 18, 1930		
28. Field-welding started July 23, 1930		
29. Erection completed Sept. 3, 1930		
30. Field-welding completed Sept. 11, 1930		
31. Base of building, 100 by 100 ft.		
32. Base of tower, 54 by 94 ft.		
33. Height, first floor to tank-room roof, 229 ft. 2 in.		
34. Height, basement floor to tank-room roof, 245 ft. 8 in.		

*Difference between shop and field tonnage due to 45 tons erected later in a two-story wing.

TABLE III.—FIELD-WELDING ON FOURTEEN-STORY BUILDING OF THE DUPONT CO., WILMINGTON, DEL.

Item	
1. Electrode melted and wasted, lb.	3,220
2. Current used, kw.-hr.	8,395
3. Total tonnage of structural steel in building, tons	1,576
4. Actual hours of welders' time, man-hours	1,411
5. Total length of $\frac{5}{16}$-in. fillets, lin.-in.	65,400
6. Fillet (in.) per ton of steel in building 65400/1576	41.5
7. Fillet (in.) deposited per welding man-hour 65400/1411	46.4
8. Fillet deposited per man per 8-hr. day, ft.	31.0
9. Fillet (in.) deposited per lb. of electrode melted and wasted 65400/3220	20.3
10. Fillet (in.) deposited per kw.-hr. 65400/8395	7.78
11. Electrode melted and wasted per kw.-hr. (in.) 3220/8395	0.384
12. Current required per lb. of electrode melted and wasted (kw.-hr.) 8395/3220	2.61
13. Welding man-hours per ton of steel in building 1411/1576	0.895
14. Electrode (lb.) melted and wasted per ton of steel in building 3220/1576	2.04
15. Electrode (lb.) melted and wasted per hour per welder 3220/1411	2.28
16. Electrode (lb.) melted and wasted per lin.-in. of fillet 3220/65400	0.049
17. Current per ton of steel in building (kw.-hr.) 8395/1576	5.33
18. Welding-machine-months	8.0
19. Steel per machine per month (tons) 1576/8	197.0
20. Fillets (all $\frac{5}{16}$-in.) per machine per month (lin.-in.) 65400/8	8,175
21. Erection started June 2, 1930	
22. Welding started June 6, 1930	
23. Erection completed August 5, 1930	
24. Welding completed August 7, 1930	
25. Height 194 ft. 4 in.; width 95 ft.; depth 184 ft.	

Natural Cement Mortar Found Strong After Half a Century

Crushing strength of 3,000 to 12,000 lb. per sq.in. displayed by 2-in. cubes cut from mill foundations built 35 and 50 years ago

By P. H. Bates
U. S. Bureau of Standards, Washington, D. C.

THERE WERE TESTED at the Bureau of Standards recently some 2-in. cubes of natural cement mortar. The results are of interest on account of the age—about 35 and 50 years—of these specimens, which were furnished through the kindness of H. D. Baylor of the Louisville Cement Co. (plants at Speed, Ind.). This organization, established in 1866, is one of the oldest in the United States producing hydraulic cements and originally made natural cement alone. In the construction of parts of its early plant the foundations were made of a concrete in which the cement used was the natural cement made by the company itself. The specimens in question were taken from these and later foundations.

Apparently the concrete was decidedly different from that made today. A mortar, about 1:2, was placed in the forms, and broken rock of rather large and ungraded sizes was then thrown into the mortar and puddled about. From the large pockets of mortar that remained after this "mixing" Mr. Baylor was able to break out pieces large enough to yield 2-in. cubes composed of mortar alone.

These foundations were in dry ground, and the portions from which the cubes were taken were above ground level. The concrete, therefore, had been subject to such a condition of humidity that much of the water for the later hardening was furnished as aqueous vapor from the air.

The mortar taken from the concrete placed 50 years ago had a distinctly darker appearance and proved to be less strong than that placed in later foundations built 35 years ago. Apparently both the cement and the sand of the two concretes were somewhat different. Attention is called to this fact so that it may not be inferred that there has been a retrogression in strength during the interval between the 35 and 50 years. The test results are given in Table I.

Of special interest, aside from the strengths obtained, is the fact that the cement was made from high magnesia rock (magnesia content probably at least 8½ per cent). However deleteriously high magnesia in portland cement may affect concrete made from it, it is evident that a much higher magnesia content in the natural cement has not given unfavorable results. Table II gives the analysis of some natural cement made in 1931 by the Louisville Cement Co. from rock of the same deposit as the cement in the old concrete.

TABLE I—CRUSHING STRENGTH OF OLD MORTAR MADE FROM NATURAL CEMENT

Specimens from foundations of Louisville Cement Co. plants built 35 and 50 years ago. Different materials were used in the two lots, and the lower strength of the older specimens therefore does not indicate retrogression of strength. Eight cubes were tested, four by Bureau of Standards and four by cement company. Each figure represents one cube.

Tested at	Compressive Strength, Lb. per Sq.In.
35 Years Old	
Bureau of Standards	11,800
Bureau of Standards	10,800
Average	11,300
50 Years Old	
Bureau of Standards	6,140
Bureau of Standards	5,320
Lousville Cement Co.	6,000
Louisville Cement Co.	2,750
Louisville Cement Co.	3,870
Louisville Cement Co.	4,000
Average	4,680

TABLE II—ANALYSIS OF 1931 CEMENT

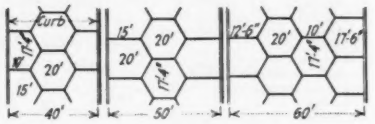
Natural cement made by Louisville Cement Co. from rock of same deposit as the cement in the old mortar specimens. Note the high magnesia content.

Item	Per Cent
SiO_2	20.18
Al_2O_3 / Fe_2O_3	6.26
CaO	46.10
MgO	13.75
Ignition loss	9.04
SO_3	2.88
Undetermined	3.23

Hexagon Slabs Pave English Highway

FOR the paving of a road, widened to 40 ft. between curbs, the concrete was poured in 20-ft. hexagonal slabs for the central portion, with slabs of approximately similar form to fill in at the sides, as described in a paper read before the British Institution of Municipal and County Engineers, by H. M. Enderby, city engineer of Canterbury, England. Widening the road necessitated the removal of old buildings with cellars, which were then backfilled to a depth of 9 ft. But time did not permit of temporary construction to allow for settlement of the fill, the method of placing and compacting of which is not described. Furthermore, the cellar walls were cut down only to the ground level, and it was felt that with ordinary concrete road construction there would be extensive cracking and failure of the slabs over these walls. (The most noted installation of hexagonal paving in the United States is at Longview, Wash. This was described in *ENR*, Oct. 8, 1925, p. 580.)

It was the author's opinion that there should be no joints parallel with the curb. Staggered transverse joints were considered objectionable as likely to cause cracks in the adjacent slabs. But with the new design, shown in the accompanying drawing, traffic crosses all longitudinal joints at an angle of not less than 30 deg.; the longitudinal joints



Slab arrangement for various road widths.

are zigzag, and the short transverse joints are in line with the widest portions of the adjacent slabs. The basis of the design is explained as follows:

Curling and hogbacking are present in all concrete slabs where the temperature of the surface varies relative to that of the roadbed. A circular slab would be affected the least, and a regular hexagon that approaches this shape has no serious curling at night or hogbacking during the heat of the day. In the latter case the under side of the slab would form a very flat dome. Although it is impossible to eliminate these faults entirely, their effect is certainly reduced by the adoption of this shape of slab.

Starting with the premise that tension may occur in any direction, the reinforcement must have a high minimum efficiency. The culmination of many experiments gave a three-way mesh with equal members crossing at 60 deg. as a good step toward the ideal. For equal weight of material it is 16 per cent stronger than four-way mesh. The bottom reinforcement is in two sheets lapped together. When curling takes place or if the subsoil is weak under the edges of the slab, the edges must be considered as cantilevers. Consequently, top reinforcement in [rectangular] strips 5 ft. wide is provided along each edge and presents the advantage of two layers at the weakest parts of the slab, which are the corners. The road mentioned embodies mesh of 8 lb. per sq.yd. at the bottom and 4¾ lb. at the top, all of high-tensile wire.

In constructing the pavement, gravel concrete was used for a thickness of 7 in. and was covered at once with 1 in. of granite concrete for the wearing surface. Between four and seven hours after placing, the concrete was wetted and swept to remove laitance and to clean the granite chips from the cement. Then twelve hours later the surface was dressed with a bitumen emulsion, the previous treatment insuring a thorough keying of this material to the concrete. Finally, a top dressing or wearing surface of tar and chips was applied to the bituminous base coat.

Roadbuilders Review Progress at Annual Convention

Seventy papers and committee reports summarize practice and opinion in finance, surveying, construction, contracting practice, maintenance, equipment and traffic

NOTABLE ADVANCE in grasping and handling the problems of highway administration and construction was exhibited in the long list of committee reports and independent papers presented last week at the annual convention in Detroit, Mich., of the American Road Builders' Association. The exhibition of roadbuilding materials and equipment was disappointing only in comparison with those of previous more prosperous business years. Its character and extent are reviewed elsewhere in this issue. General attendance was large, but, as usual, attendance at the sessions for discussing papers and committee reports was small except when subjects of current special interest, as low-cost road improvement, were being considered. In general, the sessions of the city and county officials had larger attendance than those devoted to special subjects like contracting practice or central and truck-mixed concrete. The quality of the papers and reports was high.

With 24 sessions and more than 70 technical papers and reports considered, a review is possible only of outstanding subjects. These may be classified roughly as finance, surveying, construction, contracting practice, maintenance, equipment and traffic.

Finance and administration

Five reports on highway finance and administration were presented by committees. Methods of promoting county bond issues were outlined by a committee headed by Otto S. Hess, engineer-manager of Kent County, Mich., aided by a special investigator of the A.R.B.A. staff of engineers. A statement of general principles and examples of methods followed successfully in selected cases indicated the essentials of a sound bond-issue program to be: (1) an economically sound plan; (2) a definite and well-considered construction program that can be carried to successful completion; and (3) a well-directed campaign to place the facts before the voters. Proper accounting, skilled engineering direction, ample financing for advance investigations and concerted support by civic and official county organizations were emphasized as essentials.

In financing city pavements a committee headed by Harrington Place, engineer, Detroit bureau of governmental research, recommended a classification of city pavements into four classes according to the method of financing, and into at least three types for main, secondary and outlying streets. Long-term planning looking to immediate necessities and also to holding back much desirable work to meet economic depression was urged. A pay-as-you-go policy was recommended as preferable to issuing bonds. In regard to taxes it was recommended that a cent or a fractional cent be levied on gasoline and that 30 per cent of the state gas tax be apportioned to the cities for pavement improvement at the discretion of the city paving authorities.

The general policy of centralizing road financing and administration was urged by a committee headed by Arthur W. Brandt, state highway commissioner of New York. Reviewing present administrative conditions and recent undertakings in consolidating administrative units, the report recommended: (1) township and other highway jurisdictions smaller than the county should be abolished, and their roads absorbed either into the state or county system; (2) counties without resources to support adequate highway-engineering organizations should be consolidated in respect to their highway affairs to form satisfactory highway administrative units; (3) taxation and bonding by counties for highway improvement funds should be abolished in all states; (4) there are disadvantages connected with the absolute centralization of all highways, which under present conditions make inadvisable the absorption of the county highway systems by the states. Further recommendations advise master plans for both county and state systems covering a period of years (probably five); development of the state plan by the state, and state supervision of the county plans; distribution of highway funds to secure continuity, first, of state systems and, second, of county primary systems; systematic maintenance of all improved roads and maintenance to serve traffic on secondary and tertiary highways; restriction of expenditure to a limited number of highways to serve the greatest number of people with as little expenditure as possible for the maintenance of unimproved roads, and standard specifications for all construction.

A report by W. O. Washington, county engineer, Cameron County, Tex., on specification forms, advised the adoption by counties of the state highway department standards. An appraisal of principles, practice and experience in county planning was the subject of a paper by Russell Van Nest Black, planning consultant. General principles of county planning were enunciated and suggestions made for enabling legislation, which was stated to be the present greatest need for active development.

Surveying methods and aerial location

The growing importance of surveying and route location in modern main-line road improvement was recognized by a round half-dozen reports on surveying methods and instruments and on aerial surveying. All but one of the six reports were presented by individual members of the committee under the general chairmanship of R. Getty Browning, principal locating and claim engineer of the North Carolina highway commission.

Enumerating and describing the major instruments used, H. M. Diebert, sales manager, W. & L. E. Gurley, and C. W. Keuffel, of Keuffel & Esser, emphasized the steady improvement in optical qualities, which insures better definition and increases the range of use under poor visibility conditions. Insistence was made on the purchase of instruments of high quality, their regular care and cleaning and periodic shop servicing.

Methods and instruments used in the survey of the Zion-Mt. Carmel highway in Utah and in recent surveys of the New Jersey highway department were described by Henry H. Blood, chairman, Utah state highway commission, and S. Johannesson, engineer of design, New Jersey highway commission. The Zion-Mt. Carmel survey was notable for the triangulation location of a mile tunnel line on the side of a cliff and the taking of cliff topography from a valley base line by making observations simultaneously on the same cliffside points with two transits, one at each end of the base line. In the New Jersey operations, largely in cities and over congested railway yard and main-line tracks, the ordinary instruments and methods lacked accuracy for the degree of precision required, and geodetic survey methods were followed, using a transit-theodolite and repeated angle readings and calibrated steel tapes, with tension springs and thermometers, and repeated distance readings.

The papers on aerial mapping covered much the same ground in describing instruments, photographing process and map making. Each, however, gave independent examples of specific surveys. As a method of highway location the advantages generally agreed on are: aerial maps are reliable for most practical needs, are comprehensive and con-

vincing as to details, greatly simplify location and are invaluable in appraising property for tax assessment and in preparing estimates of costs. Where confidential investigation and speed of development are essential, their value is almost beyond estimate. Mapping by experts was stressed as absolutely essential. The authors of the three reports were: Gibb Gilchrist, chief engineer, Texas state highway department; Col. R. R. Ralston, federal bureau of maps and surveys; and E. A. Griffith, chief engineer of roads, Allegheny County, Pa.

Road design and construction

Grading, concrete, brick and bituminous paving, widening and resurfacing, low-cost road surfacing, low-cost bridge work, pavement base and street railway track paving were considered in the committee work including design and construction. The reports on grading included the progress statement of the joint committee with the Highway Research Board on compaction of earth fills as affected by type and size of haulage and other equipment. J. T. Ellison, chief engineer, Minnesota department of highways, heads the committee. Examination of a wide range of literature on soil mechanics, bearing values, compaction and shrinkage disclosed no information on essential factors such as depth of layers through which various compacting devices are effective, the lag of soils under pressure, movement of soil particles under various compacting agencies, the effect of traction shear, the effect of wheel diameter, the effect of the shape of the feet on sheepfoot rollers, and the action of the water jet and the effect on it of various pressures and nozzle types. Plans for a series of tests to determine these factors were outlined. The report also described the California compaction test and gave the formulas used with it to determine compaction and shrinkage. A report by H. L. Shaner, city engineer of Winston-Salem, N. C., discussed briefly the stability of various soils for city pavement subgrades.

A group of six reports forming virtually a manual of modern practice in road surfacing were: equipment for constructing and maintaining low-cost roads, by John D. Waldrop, construction engineer, North Caroilna highway department; road mix, coarse-aggregate type, by G. C. Snyder, maintenance engineer, Ohio highway department; recent practical developments in asphalt pavement construction for (1) hot mixes and (2) cold mixes, by R. L. Morrison, professor of highway engineering, University of Michigan; construction of reinforced-concrete pavement, by C. E. Foster, chief engineer, Michigan highway department; jointing of concrete roads and concrete bases for pavement, by H. F. Clemmer, engineer of tests, District of Columbia; and brick pavement construction, by H. G. Sours, engineer, Summit County, Ohio. Contributing discussions to these reports on main surfacing practices were: bituminous-surface treatments, by C. A. Browne, engineer, Orange County, Fla.; low-cost bridges, by S. B. Slack, bridge engineer, Georgia highway department; street-railway track pavements, by R. H. Simpson, city engineer, Columbus, Ohio, and C. L. Hawkins, maintenance-of-way superintendent, St. Louis Public Service Co.; widening and reconstructing pavements, by H. G. Sours, and pavement resurfacing, by H. L. Shaner; and central and truck-mixed concrete, by R. Keith Compton, director of public works, Richmond, Va.

Cataloging these reports is all the presentation that is possible of their contents, which occupy 180 typed pages and include a score or more of tables. In general, the coverage leaves little more to be said of current practice in road surfacing. These reports on construction mark the high spot in the work of the association committees for 1931. With some reorganization of contents they leave little more to be provided to make a complete manual on highway surfacing. In particular, the census and appraisal of equipment for low-cost road construction are the most complete ever recorded.

Maintenance practice

Reports specifically on maintenance were confined to the committee on maintenance of the city officials division. This committee is headed by Maj. F. M. Davison, maintenance engineer, District of Columbia, and its report was presented in four parts covering control of utility costs; low-cost residential roads; maintenance methods and materials employed in Washington, D. C., and repair and reclamation of asphalt streets using the surface-heating method. The practices described are largely those employed in the District of Columbia and so constitute only a very good record of maintenance procedure in one city.

Highway contracting practice

The program of this group was made up of individual papers. A paper on highway maintenance and secondary-road construction by contract, by Harry J. Kirk, Associated General Contractors, stated that in 1930 maintenance cost $500,000,000 and secondary-road construction amounted to $400,000,000, totaling 45 per cent of the total highway expenditures. It has been the habit for highway departments to do both maintenance and secondary-road construction by day labor, though for no good reason other than habit. Eight states last year did some or all maintenance and secondary construction by contract, with apparently satisfactory results and at lower cost. Pennsylvania, by preparing plans for secondary construction for $75 per mile, has refuted the theory that it costs too much to prepare such plans. Ohio did patching, guard-rail construction and repair, crack filling, bridge painting and gravel hauling, by contract. The contract method should be encouraged by public officials because it makes for economy in road maintenance and construction.

A paper on wage rates on highway work, by O. W. Merrell, director, Ohio state highway department, stated that twelve states now have wage laws, seven have wage regulations, and 29 report no restriction. The recent modification of regulations by the U. S. Bureau of Public Roads regarding wage stipulations and staggering of work helps at this time. It is but a small minority of contractors that, by exploiting labor, cause all the trouble and make some sort of wage regulation necessary. Features of the Ohio law, recently enacted and working successfully, are: each county is considered as a unit, and the law stipulates that public authorities *may* state minimum wages to be paid; and, if so stated, they must be printed on the bidding blanks. Common labor rates only have been set so far and vary from 35 to 50c. an hour. Ohio is now enforcing certain labor laws that in normal times are ignored, such as the eight-hour law, in an effort to provide as much work as possible. As long as labor is exploited in trying times like these, it will be necessary for the government to interfere and establish scales.

Preferential awarding of contracts to local contractors was the subject of a paper by Frederick Hoitt, New England Roadbuilders' Association. It contended that there is absolutely no sound argument for the preferential awarding of contracts to local contractors. The benefits supposed to accrue to local labor are non-existent. Retaliation by other states is sure to come with disastrous results. The statement that out-of-state contractors do not pay prevailing wage scales is idiotic, for labor laws can be enforced against outsiders as well as against local contractors. The stay-at-home contractors are not benefited because home competition is increased. The economic independence of this nation is based on the unrestrained free trade between the states. Upsetting that free trade has proved time and time again to be unwise. Experience in Massachusetts in awarding contracts to local contractors, even though not low bidders, has proved costly to the state. And local contractors who are crying the loudest for preference are awarding subcontracts to out-of-state firms.

Replacing machinery with hand labor to relieve unemployment was discussed by Col. W. T. Chevalier, *Engineering News-Record*. In the relief of unemployment it is paramount, it was stated, that new work be found that does not interfere with or lessen the present earning power of those now employed. The funds for unemployment relief must come from those who are now earning, and their earnings must not be curtailed.

When spending money for employment relief, results should be assured. There is nothing to be gained by making our everyday program of work cost more by using archaic methods merely to put men to work. We cannot remedy local conditions by ignoring national effects. Hand labor can be used for many kinds of work that do not interfere with normal programs and that will be of some real and lasting benefit to the community.

Equipment research and standards

Five of the six committee reports on equipment were joint reports with the Association of State Highway Officials; the sixth was a review of a previous joint report on equipment-purchasing practices to adapt these practices to county requirements. A committee investigating standardization of rental rates for state-owned equipment found that some states have no rental schedules and in the others there was no uniformity of practice. The bulk of the report is a summary of the rental practices of each state. This and further information will be used to determine for future report: (1) a basis for determining rental rates for state-owned equipment; (2) proper rental-rate schedules for state-owned equipment or methods for determining rates that may be generally applied to state-owned equipment; (3) a proper relationship between rental rates recommended for state-owned equipment and privately owned equipment.

Equipment for spreading paving material and finishing pavement was limited in the report on this subject to finishing machines. For concrete it was recommended that mechanical finishing should be required, and for bituminous materials its use should be urged. Referring to bituminous pavements the report finds that: (1) although all specifications do not require the use of mechanical finishing machines, there are fifteen states at present that have used this method of finishing and are favorable to its continued use; (2) it was unanimously reported that the finishing machine has improved the smoothness of the riding surface and materially reduced construction costs as well as increased daily production; (3) from the information available there is definite indication that more uniform density is obtained through the use of the mechanical finisher; (4) spreader boxes contribute to the uniform initial spreading of the material and reduce the cost of construction; (5) with the use of mechanical finishers the smoothness of bituminous pavements may be required to be ⅛ in. when tested with a 10-ft. straightedge; (6) in order to secure more satisfactory results with mechanical finishing machines, steel forms should be used, and they should be given the same care and attention in setting and checking with a straight-edge as forms for portland cement concrete.

The committees on standardization of: (1) shoes or rollers for snow plows, reported data collected but required further time for reporting standards; (2) blades for brick scrapers, reported five sheets of standards. Bins, batchers and handling and weighing bulk cement were fully specified in the report of the committee on this subject.

Traffic regulation and safety

Eleven reports covering intersection design, lighting safety zones, laning of traffic, traffic devices, tires and general safety design presented a summary of prevailing thought and practice without bringing out anything particularly new.

Asphalt Paving Technologists Discuss Road Materials

Fine program at annual convention evenly divided between technology of materials and methods of using them

WITH its usual good judgment in selecting subjects, the Association of Asphalt Paving Technologists, at its annual meeting last week in Detroit, Mich., presented a program equally attractive to the practical roadbuilder and to the research specialists who make up the association membership. Among the papers, four were of outstanding interest to the chemist and physicist student of asphalts and the mineral admixtures used with them in producing paving materials; three others discussed roadbuilding uses, and the remaining five presented a middle ground of interest. Nine of the twelve papers recorded surveys and laboratory investigations that are now in progress, demonstrating the research activity by which the association is making for itself a high place in the councils of roadbuilding.

Surveys and technical research

Reporting on the work of the committee which is making a survey of present practice, R. L. Morrison, professor of highway engineering, University of Michigan, stated that the work of determining filler practice for sheet asphalt has been completed, and many data on mixing, rolling and other processes and materials have been tabulated but are not yet in shape to be reported. In determining filler practice 41 representative specifications were analyzed, and the results show 23 materials being used as fillers. In general limestone dust and portland cement are favored; slate dust, stone dust and silica dust follow in choice. Each specification names two or more allowable fillers, and limestone dust is named in 38, and portland cement in 32 of the 41 specifications. The percentages of filler required to pass a 200-mesh screen range from 65 to 85 per cent; in seventeen specifications it is under 70 per cent, and in only five is it 85 per cent. In line with this study, J. T. Pauls, Bureau of Public Roads, reported the material progress being made in the cooperative simplification of tests and specifications for liquid asphaltic products. Quite wide agreement of state highway departments is being reached, and all indications are that general simplification will be arrived at.

A paper on adhesion tension in asphalt pavements, by Victor Nicholson, engineering chemist, bureau of streets, Chicago, Ill., was perhaps the most provocative in character of any presented during the two sessions. Being highly technical and involving rather refined laboratory processes for its basis of supporting tests, no discussion from the floor was attempted. Briefly, the argument brought out that materials commonly used for asphaltic mortar divide into two classes, one having a greater affinity for water and the other for asphalt. Those of the first class, many of which are used in bituminous paving, make an unstable mortar, because of weak adhesion of the asphalt which is easily leached away by water. Colloids, for this reason, are an obstacle to adhesion instead of aiding it, as had been assumed. The tests also brought out that generally oil asphalts possess poorer adhesive properties than either Bermudez or rock asphalt.

Another paper on mortar materials, presented by J. S. Miller and R. N. Traxler, respectively director and research chemist of the technical bureau of the Barber Asphalt Co., described an extended laboratory investigation of the physical characteristics of mineral fillers. The study was directed particularly to the ultra-fine particles, broadly those which possess diameters less than 40 microns (a micron is about one

twenty-five thousandth of an inch; a particle 74 microns in diameter will just pass a 200-mesh screen). To secure these fine particles air separation was employed, using a recently developed apparatus by which very accurate separation of sizes is possible. These particles were then studied to determine surface area, texture and void spaces. The methods employed were described in detail, and formulas given for determining void spaces and surface area. The following table shows the type of data obtained by a particle-size analysis of a representative filler:

Size Fraction (Microns)	Per Cent by Weight	Surface Mean Diameter in Microns	Surface Area in 1 Gram of Orig. Dust (Sq.Cm.)
−2	8.48	1.00	1,988
2–4	10.24	3.00	776
4–7	8.02	5.50	331
7–10	7.78	8.50	205
10–20	25.11	16.73	336
20–40	26.29	31.75	185
40–75	13.07	57.95	51
+75	1.01	105.00	...
Whole powder	100.00	5.94	3,872

It will be noted that per cent by weight does not indicate surface area and that the ultra-fine particles account for nearly all of the surface area presented to the bitumen. Studies of these powders with bitumen are now proceeding. It appears from these that the effect of the filler in asphalt paving mixtures is dependent upon particle shape, texture, size and size distribution, upon void space in the powder, and upon the area and nature of the mineral surface presented to the asphalt.

Stability test extended

A further development of the Hubbard-Field stability test to include the coarser bituminous road mixtures, as well as sheet asphalt, was described by Prevost Hubbard and F. C. Field, chemical engineer and chemist of the Asphalt Institute. The new machine is like the older one for testing sheet asphalt mixtures, but larger, the forming and testing cylinder being 6 in. internal diameter and 6 in. high. Methods of mixing and testing both hot and cold liquid mixtures were outlined, and results of typical tests given. A paper by C. R. Stokes and Joseph Zapata, of the materials bureau of the Wisconsin highway department, outlined a series of coordinated laboratory and field tests on cold road mixes which the writers have just undertaken. The relative significance of origin and process of manufacture as affecting the character of asphalts were considered in a long paper by C. M. Baskin, asphalt technologist, Imperial Oil Refineries, Limited, Montreal, Canada.

A crack survey made of Montreal asphalt pavements was summarized by F. J. Leduc, consulting engineer of that city. These pavements have a 6-in. reinforced-concrete base on rather low bearing soil. While some cracking seemed to be due to other causes, most of it was found to originate with base failure and unevenness. The survey and tests are being continued.

Road uses of asphalt

The part of the program devoted to roadbuilding uses of asphalt was signalized by three papers of unusual interest. George W. Craig, consulting engineer, of Chicago, gave a brief description of roadbuilding operations with a new traveling road-mix asphalt mixing and surfacing plant. As an article on this plant will appear in a future issue, Mr. Craig's paper is not considered further here. A paper of broad scope on the various combinations of asphalt and gravel for road surfacing was submitted by B. E. Gray, highway engineer, Asphalt Institute.

A particular feature of Mr. Gray's discussion, which included treated gravel surfaces, road-mix surfaces and plant-mix surfaces with gravel aggregate, was the account of experience with gravel-mat surfaces on asphalt-primed earth subgrades. This portion of the paper is quoted substantially in full, as follows:

The first method of using gravel is the one of surface treatment of the natural soils. I shall cite only two instances. The clay soil of Illinois is as difficult a material to make serve as a satisfactory road surface during bad weather as any that could be named. Sangamon County, finding that funds would never be sufficient to build high-type pavements, began to experiment with asphaltic-oil treatment of the natural clay surfaces. In 1930 some twelve experimental sections were set apart and varying amounts of gravel were worked into the surface, ranging from 100 to 200 tons to the mile. In the spring of 1931 examination of these test sections showed that they had stood up remarkably well with one or two exceptions, and these were due largely to the cutting away of the oil-gravel surface with a snow plow during the winter. It must be remembered that the depth of this surfacing was only about 1 in. and that it was not antipicated that the improvement could be completed in one year but would be carried on over three or four years until stabilization had been obtained. The final report to date is that a continuation of this method will be most beneficial to the road surface.

The gumbo surfaces of the Middle West have been long famous as particularly bad roads during wet weather. A close examination and study of the make-up of this material, however, disclosed the fact that it has low capillarity and that when the surface was waterproofed, the high-support value of dry weather conditions could be maintained the year round. In this instance the application of untreated gravel to gumbo was of little avail, as during wet weather the highly plastic soil gradually absorbed the gravel and in some instances it settled through the spongy mass to a depth as much as 6 ft. below the surface, of course rapidly losing its supporting value.

Experiments were begun by the Minnesota highway department in 1925, using asphaltic road oils. The results obtained were little short of amazing. It was demonstrated that well-consolidated gumbo roads, treated with asphalt and covered with sandy gravel, will afford an excellent year-round surface that will carry traffic ranging from 600 to 1,500 vehicles per day. The first treatment employs about 1,000 cu.yd. of gravel to the mile for a surface 30 ft. wide. The asphalt is applied in three applications, the first one being a prime which is allowed to be absorbed without any cover coat. The second application is immediately covered with the gravel, and the asphalt and gravel are mixed by blading the surface until of uniform texture, after which the mixture irons out under traffic. A light seal coat is then given with a light gravel cover. The total cost of this surfacing is about $1,500 per mile.

The second year a retreatment usually is required and thereafter one every two or three years. Total costs, averaged over a period of seven years, have been from $500 to $700 per mile, including new gravel and asphalt. Gravel for this work usually has been shipped in from the outside, as there is little gravel found within the gumbo area. These are two instances of how very thin surfaces may be constructed with gravel and asphalt, and be entirely satisfactory for moderate traffic.

Asphaltic-oil treatment of earth surfaces was more comprehensively discussed in a paper by F. V. Reagel, materials engineer, Missouri highway department. Based on surveys of 224 miles of oiled roads in 1928, 1929 and 1931, and considering these classes of soils (clays, silts and sandy or gravelly soils), general results indicated mainly that (1) adequate surface and subsurface drainage is essential to the satisfactory service of oiled-earth surfaces; (2) the type of oil, as regards basic crude source, is not a major factor, all types of oils yielding fairly satisfactory results with all types of soils, other conditions being favorable; (3) soils lacking cohesion and inclined to absorb water very rapidly (represented by friable silts) are more effectively treated by oils having ductile and cohesive bases; soils having cohesion, and which do not absorb additional water unless manipulated (represented by clays) do not require oils with cohesive bases, as waterproofing without binding will insure fairly satisfactory results; (4) the condition of the surface immediately prior to the application of the oil is of major importance; the surface should be free from dust, and the soil should contain enough moisture to keep open the pore spaces; weather and temperature conditions have influence only as they affect the moisture content of the soil.

In conclusion, Mr. Reagel found that taking figures obtained from actual experience on a considerable mileage of roads, the cost of oiling earth roads and maintaining them as such, full width of road treated for the first time, is between $400 and $500 per mile. The same type of road, receiving its first annual retreatment, costs about $250 per mile. Older roads receive their annual retreatment at a cost of $200 per mile. These costs include all maintenance charges for the year and cover such items as preparing the grade, cost of and application of the oil, maintaining and patching the surface, etc.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Twenty Centuries of Bridges

REVIEWED BY LEON S. MOISSEIFF
Consulting Engineer, New York City

THE BRIDGES OF THE RHINE: Roman, Medieval and Modern. An Account of Notable Bridges Over the River Rhine and Its Tributaries, With a Description of Those Recently Built—By Karl Möhringer, Bridge Engineer. Messkirch, Baden: Joh. Möhringer. Cloth; 9x12 in.; pp. 104; many illustrations. 25 marks in Germany.

CIVILIZATION in its earlier developments has ever followed the course of rivers. The growth of the earlier African and Asiatic civilizations has been traced to the great river systems on the shores on which they developed. Transportation of human beings and commodities has always controlled the growth of nations and all important civilizations originated near large watercourses or on the shores of the sea.

The Rhine is so located in central Europe that it became the river most intimately woven into the lore and history of Europe and Western civilization. Guarded by the beautiful Rhine maidens, in it lies hidden the treasure of the Nibelungen, the gold which lures the dwarf and the knight and which radiates its curse over its possessors. On the rocks of its shores sit beautiful maidens, combing their hair and singing the youth into the perils of the Rhine. Julius Caesar leads conquering legions across its waters and Roman fortresses hold down the land. The struggle of Christianism and paganism deploys on the shores of the Rhine and the innumerable virgins of Cologne sanctify its waters by martyrdom. Crusaders emerge from the castles, clang their shields and raid the towns, and princes of the church illuminate the waters of the Rhine with the splendor of their feasts. Century after century armed men cross and recross the Rhine in the struggle of the nations and the sound of "Die Wacht am Rhein" rises and falls in Versailles.

The author of "Bridges of the Rhine" has lived in the United States and England, and realizing the lack of a book in English on the bridges crossing the Rhine and its tributaries, has written one.

The story of the bridges of the Rhine reflects the story of the inhabitants of its shores and the march of Western civilization. The bridges, by their materials and construction, by their engineering and appearance, register the technical knowledge and industry of their time and the world of thoughts and ideas of the peoples who built them. More than 50 bridges of all ages span the Rhine and illustrate the development of the art of bridge building during 2,000 years.

The first bridges over the Rhine were built by the Romans for the wars of the empire. Julius Caesar's bridge, described by him, was built about 55 B.C. in ten days, in the face of the enemy. It was probably near Coblenz and consisted of about 50 spans of timber trestles. It was 1,800 ft. long and 40 ft. wide and was supported on sloping piles driven into the riverbed. The bridge at Mayence was built in 90 A.D. by the 14th Roman Legion. A model of the pile work and of the superstructure of this bridge can be seen in the Museum of Antiquities at Mayence. Mr. Möhringer's book contains a view of the model.

A Latin inscription of the portal of the Rathaus at Cologne, the author tells us, reads:

> To Flavius Valerius Constantinus the Great, the noble fortunate sovereign, the unconquered son of the Emperor Constantine, because, to the immortal glory of the Roman Empire and to the highest benefit and embellishment of the frontier of the Empire, he built for all time to come the difficult stone bridge to march his troops across the bridge against the Franks to avoid the danger of an invasion in Gaul. He fortified both banks of the Rhine by connecting the Cologne side with the Franconian side by a yoke imposed upon the river against the enemies.
> THE SENATE AND
> PEOPLE OF COLOGNE.

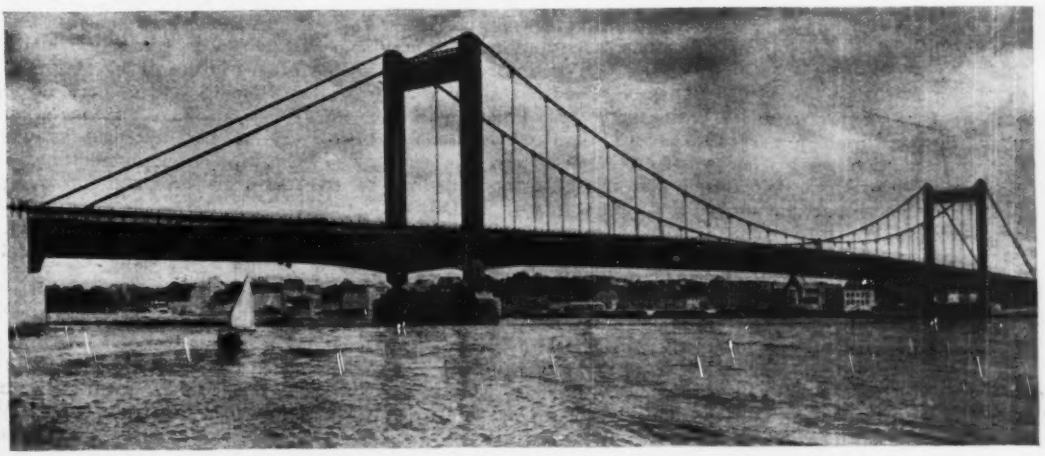
This was the Constantine bridge built in the fourth century and demolished in the tenth by order of the archbishop.

The book contains a map of the Rhine from its source at Lake Constance to its forking out in Holland. Beginning with views of the bridge at Constance, the author continues with views of the bridges of the Rhine down to Duisburg and Bommel, accompanied by short descriptions.

Notable among these bridges are: the still existing medieval bridge at Saeckingen, a roofed timber structure with two chapels in the middle, which rests on a series of stone piers, built in the eighth decade of the sixteenth century; the highway bridge at Worms, built at the end of the last century; the beautiful highway bridge at Mayence, of five steel arches; the equally beautiful highway bridge at Bonn with a central span of 615 ft.; the wrought-iron arches of the old Coblenz bridge. Last, but not least, is shown the Cologne-Deutz suspension bridge, which was begun in 1913 and completed during the war. It has a central span of 605 ft. and side spans of half the length. It is suspended from a chain of flat bars connected by pins.

The author aptly remarks that in the period of the early development of iron and steel structures

> the artistic treatment of the bridges was wholly neglected. Realization of this neg-



Cologne-Muelheim highway bridge, with 1,033-ft. main span, is the largest cable suspension bridge in Europe and is of the self-anchored type. It is also notable for its cable of 37 3-in. ropes, in each of which the five outside layers of twisted wires are of a wedge shape and interlocking type.

lect led to frequent attempts to soften the hard contours of iron structures by adding architectural ornamentation and embellishing bridges with stone portals and towers, escutcheons, and sculptures of kings and princes, such as may still be seen on many Rhine bridges.

The second part of the book is mainly devoted to a description of the Cologne-Muelheim suspension bridge, which is the latest suspension bridge of importance in Europe. Its central span is 1,033 ft. The short side spans are 300 ft. each. Only the central span is suspended. It is a highway bridge 72 ft. 10 in. c. to c. of trusses, of which a roadway occupies 56½ ft. The cables were manufactured by Felton-Guillaume and consist of locked strands with a diameter of about 3⅛ in. Thirty-seven such strands make up the cable. The towers are of the rocker type and the German variety of silicon steel was used in its fabrication. The design was well worked out in its details. The Cologne-Muelheim bridge has been described by the engineers who participated in its design and erection in a monograph in German published by Wilhelm Ernst & Sohn, Berlin. It is the most notable bridge on the European continent.

The photographs are well reproduced and the make-up of the book is excellent. The author has done a service to English reading engineers by producing this book.

Runoff From Mountainous Areas

REVIEWED BY I. GUTMANN
Associate Editor "Engineering Index." New York City

HYDRAULICS ENGINEERS concerned with runoff from mountainous watersheds of high elevation will be greatly interested in bulletins 5 and 6, of Series 10, recently published by the Po River Hydrographic Office of the Department of Public Works of Italy (R. Ufficio Idrografico del Po, Parma, Italy).

Bulletin 5, by L. Gherardelli, is entitled "Il Dominio Glaciale Nells Valle D'Aosta e Sua Influenza sul Regime dei Deflussi" (15 pp. and two plates). It treats of the hydrology of an Alpine watershed in northern Italy, having an area of 1,285 square miles with elevations up to 13,000 ft. above sea level, which is largely fed by glaciers forming 7.1 per cent of the total drainage area. The altimetric distribution of glacier areas and the discharge of Dora Baltea and other streams, by months, are among the data presented. Discharge from glaciers as a function of temperature and the diurnal fluctuations in glacier discharge are discussed at some length.

Bulletin 6, by Prof. U. Monterin, is entitled "Ricerche sul Ablazione e sul Deflusso Glaciale nel Versante Meridionale del Monte Rosa" (75 pp., 13 fig.). It describes the construction and operation of various special instruments which were used in measuring the ablation, or melting, of glaciers located on the southern slope of Monte Rosa, in the Italian Alps, at elevations reaching nearly 15,000 ft. above sea level. It treats of research work, done at the meteorological and geophysical observatories of Monte Rosa, on correlation between ablation and various meteorological factors, particularly the laws of variation of ablation with atmospheric temperature and the variation of ablation and temperature with elevation above sea level. Many local data are presented which, among other matters, demonstrate the relation between ablation and runoff.

Conservation

CONSERVATION in the Department of the Interior—By Ray Lyman Wilbur, Secretary, and William Atherton Du Puy, Executive Assistant. Cloth; 6x9 in.; pp. 253; many illustrations. $1 from Superintendent of Documents, Washington, D. C.

SECRETARY WILBUR and his executive assistant have produced fifteen interesting pen sketches, supplemented by many halftone views, under the title "Conservation in the Department of the Interior." They deal with the irrigation works of the Reclamation Service, the Hoover Dam ("Shackling the Colorado"), oil, natural gas, national parks, public lands, the Indian, the child, the work of the Geological Survey and other activities. The popular character and low price of the volume favor a wide circulation with a desirable increase in knowledge of the work done by one of our large government departments.

Public Addresses and Private Diversions

ENGINEERS, ENGINEERING, AND SOME VAGARIES—By Edward E. Wall, M.Am.Soc.C.E., M.A.W.W.A. Cloth; 5x8 in.; pp. 306. Privately printed for the author, 5361 Pershing Ave., St. Louis, Mo.

OCCASIONAL addresses and a few essays and verses of a more personal character make up Mr. Wall's "Engineers, Engineering and Some Vagaries," printed for private circulation among his friends. In view of Mr. Wall's long connection with the St. Louis waterworks, latterly for many years as commissioner, it is not surprising that many of the addresses relate to the waterworks of St. Louis and the important extensions made under his direction. Most of the other addresses deal with municipal affairs or with the engineer and his profession. One of the most significant of the essays is on "Labor and the Municipality," in which Mr. Wall draws on his long and varied experience. Among what the author presumably classes as "Vagaries" is a summary of the outcome of many thousands of games of solitaire of various kinds played by Mr. and Mrs. Wall in the last seven years, including the "numbers of games played between games won." The volume is a welcome addition to the few collections of their own papers and addresses brought together by American engineers. The author's reflections on the education and public relations of engineers and on the problems encountered by the engineer in municipal service deserve wide reading by engineers, city officials and laymen.

Transportation in War

TRANSPORTING THE A.E.F. IN WESTERN EUROPE, 1917-1919—By William J. Wilgus, Member Military Railway Commission to England and France, Director of Military Railways, A.E.F., Deputy Director General of Transportation, A.E.F. New York: Columbia University Press. Cloth; 7x10 in.; pp. 612; maps and tables. $12.50.

FEW PEOPLE outside of the transportation corps of the American Expeditionary Forces in France realize the magnitude of the task of transporting men and materials from the ports to the battlefront which was placed upon that branch of the army service. None of the other participants in the World War had to face such a problem and none entered the conflict with so complete lack of preparedness for the organization and operation of a service upon which, ultimately, the whole success of their undertaking was to depend.

These considerations need to be borne in mind by the uninitiated who turn to Col. Wilgus' historical record for light upon the Transportation Service of the A.E.F. Otherwise the undertone of complaint running through the whole book will be taken as a reflection upon the efficiency of service itself rather than as the author's involuntary expression of protest against conditions beyond the control of the men who directed its operations.

The book is a very complete record of the organization and accomplishments of the Transportation Service and its antecedents back to the Military Railway Commission headed by Major Wm. Barclay Parsons, of which Major Wilgus was a member, which went to France in the spring of 1917. The limited facilities at the ports through which American men and materials entered France are described as well as the plans for providing additional berths for American ships and enlarged port storage facilities. Between the ports and the front the Transportation Service laid out and built, in cooperation with the division of construction and forestry, several great storage depots, ammunition depots, engine terminals and car and locomotive repair shops; it also added numerous sidetracks and connecting lines to the French railways to facilitate American train movements to the front. These works are fully described

and illustrated with maps and diagrams. Train services maintained by the American railway operating troops also are described, as are the related inland waterway and port transport services. Considerable space is given to the matter of ocean shipping and to the problems of integrating American shipping needs with those of the Allies.

An especially illuminating chapter is one devoted to French comment on the American transport service; disconcerting comment were it not known that the petty politics played by the French railway officials was responsible for some of the difficulties of the American railway men.

In his introduction Col. Wilgus states that his purpose in being frankly critical of many happenings in connection with the transportation of men and material is to emphasize the lessons to be learned from the mistakes of that great undertaking. It is to be hoped that his demonstration of the regular army's reluctance to revamp its established organization to meet new conditions will have the desired effect, but if the picture drawn by Col. Wilgus of utter lack of appreciation by "higher authority" of the need for such reorganization is a correct one there is little reason to expect that his desire will be realized.

Small Water Supplies for Dry Countries

A PRACTICAL HANDBOOK OF WATER SUPPLY — By Frank Dixey, O.B.E., D.Sc., F.G.S., F.R.G.S., Director of Geological Survey, Nyasaland. London: Thomas Murby & Co., Fleet Lane, E.C. 4. Cloth; 6x9 in.; pp. 571. Line cuts. 21 shillings from English publishers; $8.50 from D. Van Nostrand Co., New York City.

WRITTEN primarily for those who have occasion to provide small water supplies for European and native settlements in central and eastern Africa, Dr. Dixey's "Practical Handbook of Water Supply" contains much information of value in other dry tropical and sub-tropical countries as well. In the parts of Africa for which it is designed it should be a godsend. Most of the volume is devoted to underground and surface waters, well-sinking, dam, reservoir and tank construction and water treatment. The author has made wide use of pertinent information from all over the world, including the United States.

The closing part of the book contains geological, meteorological and other information regarding South Africa, Rhodesia, Nyasaland, Tanganyika, Kenya and Uganda that throws light upon the water-supply problems of those regions and how much yet remains to be done in providing for their present and future water-supply needs.

Aside from the usefulness of the book, it contains much interesting information regarding little-known parts of the world, their scanty water supplies and strange ways and means of water conservation—as gathering water and even dew on corrugated iron surfaces, dependence for weeks on the water in melons and other fruits to quench thirst and even killing animals that have unique water storage facilities as a part of their internal economy.

The many illustrations are well chosen. The line sketches and drawings, as well as the accompanying descriptive matter, should be very helpful to pioneers in providing small water supplies.

Early Literature on Railways

RAILWAY LITERATURE, 1656-1830: A Handlist—By R. A. Peddie, Author of "National Bibliographies." London: Grafton & Co., 51 Great Russell St. Cloth; 5x7 in.; pp. 78+ a 16-p. "Catalogue of Old and Curious Railway Books, Pamphlets and Maps." 10s. in England.

FORTY entries in this useful and interesting list antedate 1801. The first of these is a reference to railways in mines, in Agricola's "De Re Metallica." As this old treatise was printed in medieval Latin, it would have been useful to many had Mr. Peddie stated that it is available in an English translation made by President and Mrs. Herbert Hoover nearly twenty years ago. Many American railway projects are listed. Mention is made of a chapter on "Cast Iron Railroads" in Robert Fulton's "Treatise on Canal Navigation, London, 1796." This book is described in much more detail in the catalog at the end of the volume, where it is said to have contained seventeen plates drawn by Fulton and is listed at five guineas ($51.14 at normal rate of exchange). That as late as 1830 skeptics were not convinced of the financial practicability of steam railways is shown by an entry by an anonymous writer who called himself "Investigator" and entitled his pamphlet (?) "Remarks on the proposed Railway Between Birmingham and London proving that it would never pay."

Two-Billion-Dollar-a-Year Menace

THE INSECT MENACE—By L. O. Howard. New York and London: The Century Co. Cloth; 6x9 in.; pp. 347; illustrated. $3.50.

THE primary object of Dr. Howard's "Insect Menace" is to drive home just what the title implies, emphasized by an estimate of two billion dollars as the yearly damage wrought by insects in the United States alone. In doing this he has written a most fascinating account of insect life in general and of the more destructive insects in particular, the habits of the latter, the damage they do to crops and to human beings, the means employed to combat them and the need for a more intelligent and intensive war against the hordes of insects that are a menace. For the armies of beneficial insects he has good words. For those who do not know, it may be said that for years Dr. Howard was chief entomologist of the U. S. department of agriculture and that among other things he did valiant work in combating the "typhoid fly."

An Eye-Opener to Many

FEDERAL SERVICE TO MUNICIPALITIES—By Paul V. Betters, of the staff, Institute for Government Research for the Brookings Institution, Washington, D. C. Publication No. 24, Municipal Administration Service, 261 Broadway, New York City. Paper; 6x9 in.; pp. 100. 25c.

ONLY those who never looked into the subject would suppose that one or more kinds of service are being rendered to municipalities by seven of our federal departments and by a number of boards and commissions. The total varieties of assistance named in the contents of Mr. Better's "Federal Service to Municipalities" is about 75, to say nothing of minor aid not listed. The information is given in narrative form under each government department or board. There is no functional classification, but a detailed index makes it possible for those interested to make up a summary of their own. Among the many subjects on which federal aid or information is supplied are testing, purchasing, city planning, zoning, building, and plumbing codes, all by the Bureau of Standards; smoke abatement, fuel analysis, tunnel ventilation, harbor pollution, by the Bureau of Mines; airport ratings, by the Aeronautic Branch; hydrography and topography, by the Coast and Geodetic Survey; financial statistics of cities by the Bureau of the Census; protection of water supplies, by the Forest Service; milk sanitation surveys, by the Public Health Service; beach erosion and port development, by the war department. These are only a few samples. The study is one of enumeration and description rather than criticism, although general mention is made of overlapping services. The contents do not show that the Public Health Service makes studies of sewage disposal and the pollution of water supplies. The study should be an eye-opener, whether one thinks that the federal government should do more or less for municipalities.

Publications Received

THE PORTFOLIOS on "Wood Sash Frames" noted on p. 977 of our issue of Dec. 17 is not free on application generally, but merely in the "local Northwest." Elsewhere the price is $2. (West Coast, Lumbermen's Association, Seattle, Wash.

THE PRICE of single copies of the Clay Products Institute *Journal* is 75c. instead of 50c. as stated in our notice of the first issue of the periodical, published in these columns Dec. 17, 1931. Membership in the

society is $3 a year and covers the *Journal*, which is published at 1420 New York Ave., Washington, D. C.

DEUTSCHER REICHBAHN - KALENDAR, 1932, is in desk-pad form with a page for each day devoted to some city or industry or some part of the German railway system. Besides text, each sheet contains a handsome halftone view. (4 marks from Konkordia-Verlag, Goethestrasse 6, Leipzig, Germany).

AIRWAY BULLETINS Nos. 1 and 2, compiled by the aeronautics branch of the U. S. department of commerce, are entitled "General Airway Information" and "Descriptions of Landing Fields in the United States." They supersede and amplify "earlier loose-leaf airway bulletins on matters essential to the safe and reliable operation of aircraft in cross-country operations." The airports described in Bulletin No. 2 are arranged alphabetically, by and within each state. No. 1 has 184 pp., including maps, and No. 2 has 169 pp.

THE INVESTIGATION of laminated and spiral springs with reference to materials, design and methods of suspension of vehicles, begun in 1922 by the springs research committee of the (British) department of scientific and industrial research, seems to have been brought to an end by a report dated Aug. 31, 1931. Conclusions and recommendations of interest to makers and users of springs are given. (Paper; 6x10 in.; pp. 75; illustrated. 15d. plus postage from any H. M. Stationery Office; 35c., plus postage, from British Library of Information, 270 Madison Ave., New York City.)

INTERSTATE WATER RIGHTS was the subject of two important papers read before the New England Water Works Association, since reprinted from the *Journal* of the New England Water Works Association for September, 1931 (pp. 199-301). One was entitled "The Law of Interstate Waters and Its Application to the Case of the Delaware River" (New Jersey vs. New York, with Pennsylvania intervening) and was by Thaddeus Merriman, chief engineer, board of water supply, New York City. The other, by Frank E. Winsor, chief engineer, Metropolitan District Water Supply Commission of Massachusetts (Boston), has as its title "Diversion of Interstate Waters for Domestic Supply: Litigation and United States Supreme Court Decision in Case of Connecticut and Massachusetts." Reprinted for private circulation.

THE GEOTECHNICAL COMMITTEE of the Government Railway of Japan, through its research office at Tokyo, is publishing a series of bulletins (in Japanese) dealing with investigations made or in progress since its organization on Nov. 21, 1931. The committee is investigating "native soils of various districts" of Japan "where railway construction and improvement works are" under way or projected, as well as ways and means of applying the results of the studies to the design of structures, particularly with "reference to the nature of soils of working sites." The first bulletin, dated June, 1931, contains 338 pp. (in Japanese) with line cuts and halftones in the text, besides many folding plates. This bulletin contains several reports—some on "Soil Science" and some on "Engineering"; a number of papers by Japanese writers; and "Abstracts of Selected Articles" by D. R. Hoffman, C. Terzaghi, D. P. Krynine and G. Spackeler.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

ASSOCIATION OF FIELD ENGINEERS, U. S. Coast and Geodetic Survey. Bulletin No. 4, December, 1931. Paper; 8x11 in.; pp. 124; mimeographed. Address the organization named, care of U. S. Coast and Geodetic Survey, Washington, D. C.

CLAY-PRODUCTS INDUSTRIES (other than pottery) and Sand Lime Brick—Census of Manufactures, 1929. Paper; 9x11; pp. 17; tables. 10c. from Superintendent of Documents, Washington, D. C.

COMPARATIVE TAX RATES OF 290 CITIES, 1931—By C. E. Rightor, Detroit Bureau of Governmental Research. New York: Municipal Administration Service, 261 Broadway. Paper; 7x10 in.; pp. 15; tables. 20c.

The tenth annual "compilation and comparison of municipal tax burdens." Tables arranged in order of size of cities give population, assessed valuation, per cent of taxes borne by realty and personalty, tax rates for city, school, county and state purposes, with total, adjusted to uniform basis of assessment; estimated ratio of assessed value to legal basis; and final readjusted rate.

CONDEMNATION PROCEDURE IN KANSAS CITY — Survey and Report Made for the Property Owners' Division of the Real Estate Board of Kansas City, Mo. Public Service Institute, 501 Orear-Leslie Bldg., Kansas City, Mo. Paper; 8x11 in.; pp. 72; mimeographed.

DAILY RIVER STAGES at River Gage Stations on the Principal Rivers of the United States, 1930—Compiled by Montrose W. Hayes, Principal Meteorologist, U. S. Weather Bureau. Paper; 9x12 in.; pp. 156; tables. 50c. from Superintendent of Documents, Washington, D. C.

ECONOMICAL USE OF LARGE TILE FOR LAND DRAINAGE—By Roger D. Marsden, Senior Drainage Engineer, Bureau of Agricultural Engineering. Paper; 6x9 in.; pp. 24; line cuts and tables. 5c. from Superintendent of Documents, Washington, D. C.

GOVERNMENT SERVICES AVAILABLE TO CIVIL ENGINEERS—[Manuals of Engineering Practice, No. 7.] Paper; 6x9 in.; pp. 36; 25c. to members and 50c. to non-members, American Society of Civil Engineers, 33 West 39th St., New York City.

Alphabetically arranged by kind of service from acoustics to zoning. Much information also given in government organization charts.

HIGHWAY SERVICES AND COSTS (in New Jersey)—Report No. 5, Commission to Investigate County and Municipal Taxation and Expenditures, J. F. S. Fitzpatrick, Secretary, Jersey City, N. J Paper; 6x9 in.; pp. 89; tables.

Includes roads and streets, which together comprise "the second largest item of all state and local expenditures, being exceeded only by education." Has a chapter on "Special Assessments for Streets." Closes with recommendations.

INCREDIBLE CARNEGIE: The Life of Andrew Carnegie (1835-1919)—By John K. Winkler, Author of Morgan the Magnificent, etc. New York: The Vanguard Press. Cloth; 6x9 in.; pp. 307; illustrations. $3.50.

INVESTIGATIONS OF LOADS ON THREE CAST IRON PIPE CULVERTS UNDER ROCK FILLS—By M. G. Spangler, Associate Structural Engineer. An Investigation Conducted by the Iowa Engineering Experiment Station in Cooperation with the Iowa State Highway Commission and the U. S. Bureau of Public Roads. Paper; 6x9 in.; pp. 36; tables and illustrations. Bull. 104, Iowa Engineering Experiment Station, Ames, Iowa. Free on application.

MECHANICAL WORLD YEAR BOOK 1932—Manchester and London, England: Emmott & Co., Ltd. Cloth; 4x6 in. pp. 361; tables and graphs.

THE MISSISSIPPI RIVER AND VALLEY: Bibliography: Mostly Non-technical. Paper; 6x9 in.; pp. 116. 10c. from the Engineer School Library, Army War College, Washington, D. C.

PILE-DRIVING AND THE SUPPORTING CAPACITY OF PILES—By Roland Bennett, M.C., B.Sc. (Engineering), Assoc.M.Inst.C.E. [Selected] Papers. Boards; 5x8 in.; pp. 15; illustrations. London: Institution of Civil Engineers, Great George St., S.W. 1.

PROPERTIES OF FIBER BUILDING BOARDS—By C. G. Weber, F. T. Carson, L. W. Snyder. Miscellaneous Publication, Bureau of Standards, No. 132. Paper; 6x9 in.; pp. 14; line cuts and tables. 5c. from Superintendent of Documents, Washington, D. C.

PUBLIC EMPLOYMENT IN THE UNITED STATES, Extent, Costs and Significance—By William E. Mosher and Sophie Polah, School of Citizenship and Public Affairs, Syracuse University. Supplement to the National Municipal Review, January, 1932. Paper; 7x10 in.; pp. 75; tables. 25c. from National Municipal League, 261 Broadway, New York City.

Covers federal, state, county, city, town and school district governments, with some of the figures estimated—mostly for the calendar year 1926 or the fiscal year 1926-27.

THE QUEEN OF THE SCIENCES—By E. T. Bell, Ph.D., Professor of Mathematics in the California Institute of Technology. [A Century of Progress Series.] Baltimore: The Williams & Wilkins Co., and Associates in Cooperation with The Century of Progress Exposition. Cloth; 5x7 in.; pp. 138; graphs. $1.

The author's viewpoint is expressed in his opening chapter by the following quotation from Gauss (1777-1855): "Mathematics is queen of the sciences and arithmetic the queen of mathematics. She often condescends to render service to astronomy and other natural sciences but under all circumstances the first place is her due."

STANDARD CONSTRUCTION METHODS—By G. Underwood, Construction Engineer, Author of "Estimating Construction Costs." Second Edition. New York and London: McGraw-Hill Book Co. Flexible; 6x9 in.; pp. 501; photographs and line cuts. $5.

STANDARDS AND RECOMMENDED PRACTICE FOR RAILROAD HIGHWAY GRADE CROSSING PROTECTION. Bulletin of Joint Committee on Grade Crossing Protection, American Railway Association, G. E. Ellis, Secretary, Transportation Building, Washington, D. C. Paper; 6x9 in.; pp. 27; tables and line cuts.

STEEL STRUCTURES RESEARCH COMMITTEE (First Report) of the [British] Department of Scientific and Industrial Research. Paper; 6x10 in.; pp. 276; line cuts and halftones. 5 shillings plus postage from H. M. Stationery Office, London; $1.30 plus postage from British Library of Information, 270 Madison Ave., New York City.

THE STORY OF THE ROAD From the Beginning Down to A. D. 1931—By J. W. Gregory, F.R.S., LL.D., D.Sc., Emeritus Professor of Geology at the University of Glasgow. New York: The Macmillan Co. Cloth; 6x9 in.; pp. 311; four maps and 30 illustrations. $4.

SYMPOSIUM ON WELDING—Held at the Pittsburgh Regional Meeting, American Society for Testing Materials, Pittsburgh, Pa., March 18, 1931. Pittsburgh, Pa.: American Society for Testing Materials. Cloth; 6x9 in.; pp. 152; tables, line cuts and illustrations. $1.75.

TRIANGULATION—Serial 529. Paper; 6x9 in.; pp. 19; illustrations. Free on application to Director Coast and Geodetic Survey, Washington, D. C.

WATER-BORNE COMMERCE OF THE UNITED STATES FOR THE CALENDAR YEAR 1930 — From Annual Report Chief of Engineers, 1931. Paper; 6x9 in.; pp. 1074; tables.

ZUR BEHANDLUNG BAUSTATISCHER AUFGABEN ALS RANDWERTPROBLEME—Von Dr.-Ing. Karl Schäfer. München and Berlin: R. Oldenbourg. Paper; 7x10 in.; pp. 77; line cuts and tables. 5 marks.

Letters to the Editor

Manslaughter Conviction Claimed Unfair

Sir—I feel compelled to protest the articles in your issue of Dec. 3 entitled "Designer of Failed Coal Pocket Guilty of Manslaughter," p. 899, and "Design Responsibility Made Real," p. 871. They include false and misleading statements, and it is not stated upon whose authority they are made.

Paul Orzel, the convicted engineer, is a man of 26 years' experience in designing and detailing structures, and at the time he was engaged by the Central Structural Steel Co. to make the drawing substituting steel members for the wooden ones shown on the designer's drawing he was largely engaged in perfecting four patents which he now holds. I have been acquainted with him for 25 years. He has never before been accused of a misdemeanor or irregularity of any kind.

The case is being appealed, but in the meantime the readers of *Engineering News-Record* should know: that the structure was built without any building permit whatever; that it was built without any engineering inspection or supervision; that Mr. Orzel's advice to build the structure on pile foundations was not followed; that Mr. Orzel was unaware of the three foregoing facts; that in the Bronx trial all defense testimony in regard to the failure of the foundations was ruled out, although according to sworn testimony the foundations were built without a plan, and one foundation had tilted and sunk 4½ in.; that the foundations had been built up and repaired by one of the state's own expert witnesses after the collapse; that the testimony showed the steelwork to have been erected in a highly incompetent and slipshod manner; and that in the appeal the defense, among other things, plans to prove that the testimony of the state's four expert witnesses, which had an important and material effect upon the judge's and the jury's decisions, was false and misleading in major particulars.

Mr. Orzel's friends feel that the conviction is grossly unfair and that it was obtained in an unjust manner. They think it particularly unfair to exclude from the evidence a full-size test of the identical construction criticized by the state's experts, which showed that this construction could carry without any signs of weakness greater loads than could possibly have been imposed in the structure, provided that the foundations had been reasonably fixed and the steel erected in a reasonably workmanlike manner.

In his examination of the central foundation of the collapsed portion the writer found that the column center was only within 4 in. of the middle third limit in the 8-ft.-wide foundation, and that under full load the maximum soil pressure was 7,140 lb. per sq.ft. for filled-in ground overlaying Harlem River mud.

The readers of *Engineering News-Record* should withhold their judgment until the case can be reviewed.

New York, N. Y. PAUL CHAPMAN,
January 7, 1932. Structural Engineer.

The information upon which our news account was based was obtained from the assistant district-attorney of Bronx County and therefore presumed to be substantially correct. —EDITOR.

Timed Public Works

Sir—The article of Prof. Ward L. Bishop entitled "Timed Public Works a Fallacy," in your Dec. 17 issue, is so contrary to present-day thinking that a rebuttal is in order.

The reasoning employed by Professor Bishop in setting out his case is rather involved, but the important thing to remember is that he differs with the steadily growing school of thought that believes that long-range planning of public improvements and their release during gloomy times promises better results than former practices.

It seems to me that, if public authorities will schedule their physical requirements several years in advance, and at the same time effect a fiscal policy permitting a reserve of borrowing power, no sensible man should raise his voice against it. The home that forecasts its necessities and its financial resources is conducting itself on a better plane than if only the problem of the moment is met. From the individual home up to our great corporations this same principle of studying the future and preparing for eventualities is profoundly sound. It also seems sound that public officials from the federal government to the town unit are far better prepared for emergencies if they forecast their revenues and their expenditures.

In my judgment, if the government, states, counties and cities are in possession of their requisites for several years to come and can thus express better judgment both in timing and placing projects on the market, a more logical business procedure will be established.

Many localities have demonstrated, I think, in the last year or two that money invested in public improvements has been helpful in relieving unemployment. A greater measure of relief can be anticipated if all political bodies will foresee the future and provide a reservoir of money, as well as work, which can be released to put idle men to work.

The gain, of course, in timing public works is not wholly in terms of employment, but it has striking advantages in other directions. I think we can grant that public officials, in most instances, reason out improvements from the standpoint of the individual project itself based on the expediency of the moment. Frequently the funds invested in this manner set up a train of circumstances not foreseen. Likewise, with a limited income, the government under this process may invest an undue amount in a particular character of work to the disparagement of others of greater importance. If administrative officials had before them a program of improvements charted years in advance, the discretionary eye could be fixed upon these and more judicious allocation of funds be made.

Again, let me say, on the planning of public works, any viewpoint against better processes of government that can be practically established and effectively executed is untenable. D. H. SAWYER,
Director, Federal Employment Stabilization Board.

Washington, D. C.
Jan. 8, 1932.

* * *

Sir—The article on public works in depressions by Prof. Ward L. Bishop must have been a surprise to many of your readers. During depressions there is naturally a search for means of stabilizing employment opportunities. Many have come to believe that public construction can be used for that purpose, and to that end they advocate that public works should be curtailed when private industry and business is active, and increased to take up the slack when private employment cannot find use for the available workers.

Professor Bishop himself does not approve of this plan. He develops arguments based on the financial aspects of the suggested policy, and he concludes that the financing required during depressions would place a strain upon the capital market and magnify the depression. In effect, his article gives two theories that lead to opposite conclusions. Naturally he favors his own theory, but he makes no direct attempt to prove the fallacy of the other.

Professor Bishop sees business activity as resulting from the probability of high profits, and he assumes that business expansion will be checked when profit margins are reduced. To some extent this may be so, but there are reasons for doubting the absolute validity of these assumptions. Labor naturally prefers the good job to the poor one; but if the first is lacking, it will, and indeed must, take the second. The position of capital differs only in degree. It prefers the high profit and can let the small profit go by, if it appears probable that better terms can be obtained within a reasonable length of time. But capital must have employment in the end, and a small profit is quite acceptable if nothing better is to be had. Witness the present ready sale of short-term government notes at insignificant rates of interest.

Professor Bishop shows that the post-

ponement of public works during periods of expansion would increase the amount of capital and labor available for industry. He assumes that this would result in a further increase in the expansion program, and he concludes that the timing of public works as now commonly advocated would lead to still greater overexpansion, to be followed by magnified depressions. In some respects this sounds plausible, but is it valid?

The individual business must needs be concerned about the amount of capital and labor it has available, but this is not necessarily true in the case of the nation. We have more capital and more labor now than in 1916 when they served to support a degree of activity that we today would consider most satisfactory. And there is no need of arguing about our supply of labor. Possibly all that business needs today is the ready sale for its products that it had in 1916. To prosecute public works on a scale sufficient to provide reasonable employment opportunities at all times would insure a satisfactory purchasing power.

Trenton, N. J. Dec. 19, 1931. ALBIN G. NICOLAYSEN.

* * *

Sir—Prof. Ward L. Bishop's article (*ENR*, Dec. 17, 1931, p. 965) on the fallacy of timed public works hits the nail pretty well on the head, but it disregards the existence of a lot of other nails. So far as municipal public works are concerned, he is perfectly correct. The limitations of his paper consist in neglecting the specific characters of federal work.

Federal work in hard times can be financed by national bonds, which can be used as a basis for the issuance of new currency and are therefore an element of inflation. This is the opposite of the effect of municipal bonds, which Mr. Bishop so clearly explains. By the same token, the retirement of federal bonds in good times requires the retirement of currency and is an element of deflation. So the effect of federal work is not like that of local projects.

The other difference in the case of federal work is that it can be paid for out of income taxes, and if it is so paid, its effect is to stabilize industry. Mr. Bishop's argument that the taxation involved in public works aggravates the overaccumulation of capital is quite correct in the case of municipal taxes, which come out of buying power and business. The upper brackets have the opposite effect, as they come almost entirely from capital money; they therefore tend to reduce the burden of overbuilding and the amplitude of the cyclical swing. They have another virtue: they are collected almost entirely in good times; during hard times they mostly dry up. This means that they bear down on good times and let up in bad times, which is all to the good.

As for burying or sterilizing funds for a few years, which Mr. Bishop so casually dismisses as uneconomical: as a matter of fact, as he clearly shows in the same paragraph, it would be one of the best investments the country could make.

It does not seem so impossible that after discussion has done its work we might come to the adoption of the obvious adjustment of the various factors of overequipment so as to produce a fair degree of stabilization. It is true that timing of municipal construction is too naïve, but that is no reason why engineers should not insist on a sound fiscal program.

New York City, Dec. 18, 1931. DAVID CUSHMAN COYLE, Consulting Engineer.

* * *

Sir—In your issue of Dec. 17 Prof. Ward L. Bishop undertakes to shatter an opinion held by many that the ups and downs of industrial activity can be tempered by alternately holding back and releasing public work. He clearly states the reasons for this opinion. They are plausible, but the writer believes they are fallacious.

The foundation of his argument is that industrial activity is not only limited but controlled by the amount of capital and labor available, and that, as public works draw from the same pool as private industry, to increase the former in times of depression must result in diminishing the latter, and to curtail public works in boom times must lead to further expansion of private construction.

Is not this theory blind to the major causes of expansion and contraction of industrial activity? Granted that such activity may have an ultimate limit at any time, fixed by the amount of labor and capital that can be obtained, is there any evidence that we reached that limit in 1929? Just prior to the sudden drop in security values, which may be considered the beginning of the present depression, capital was so abundant that it sought outlets in huge quantities in foreign countries. Labor was sufficiently abundant to induce drastic limitations on immigration. In 1930 the amount of capital seeking safe and profitable employment was reflected in the lowest interest rates known to this generation, while national efforts were inaugurated to keep men from being discharged. Surely there was no limitation of industry by available capital or labor then, and yet there was a persistent decline in production.

The author's theory is submerged by more powerful forces, some of which are psychological.

Under the conditions of 1930, with a surplus of idle capital, and labor and private industry in confusion, was it not reasonable for the federal and state governments to put these forces to work in building more highways, river improvements and public buildings, under the most favorable conditions as to cost and speed that had existed for at least many years? There is nothing in Professor Bishop's article to show that it was not reasonable, nor is there any evidence that such public work took from private work the labor and capital that private work would have used had the public work not been done.

Norfolk, Va., Dec. 28, 1931. PAUL L. REED.

Causes of Landslides

Sir—I have noticed in "Some Theoretical Considerations on Landslides" in your issue of July 16, 1931, and "Unknowns in Earth Pressure" in the issue of Oct. 1, 1931, some interesting considerations. The writer has had occasion to study that question, for effective defense of the both banks of a canal in Campos, Estado do Rio de Janeiro, Brazil. In those studies the author inferred that there was no theoretical consideration useful in solving the problem economically.

The experiments of Prof. Dimitri P. Krynine (July 16, 1931) may be studied by means of mathematical and practical formulas published in *Beton und Eisen* (1909), by Ullmann; they will not, however, completely solve the problem because the whole of the slope surface stands unprotected from weather.

With regard to sliding surface, the reader is referred to the studies of Lieut. E. Peterson, in Kajraset i Göteborg, March 5, 1916, and also Grus Fillingar för Kajbyggnador Bitrag Sven Hultten, Tek. Tidskr, 1916, also Krey, Erddruck und Erdwiderstand.

Prof. Krynine has good reason for stating, "The logical procedure is by draining the soil. Good drainage is the first prevention against landslides."

Jacob Feld (Oct. 1, 1931) is a pessimist about drainage in some cases, but, I am sure the wide experience of R. Bruere expounded in "Traité de Consolidation des Talus" may be applied with success anywhere. Mr. Bruere had more than twenty years of practice in this subject.

At the end of his article, Jacob Feld says: "The writer has never found a satisfactory solution to the problem of post and tower foundations where horizontal pulls occur either from lateral cable or guy loads with or without wind pressure." On this point the reader is referred to "Beitrag zur Berechnung von Mastfundamenten," by Dr. Ing. H. Frölich, and "Freileitungs bau," by F. von Kapper, wherein the question of post and tower foundation is masterfully treated. The scantiness of room prevents my demonstrating what happens when a 5-ft. penetration occurs in sheetpiling.

Finally, the easiest way to prevent landslides is as follows: (*a*) deep ditching, deeper than the height of the slope and as near as possible to the slope

crest; (*b*) keeping the angle of the slope as low as possible to reduce the velocity of water on the surface of the slope when rain occurs; (*c*) giving the greatest possible resistance to the "whole" surface against erosion by means of mineral or vegetable protection.

MANFREDO DE ARAUJO CARVALHO.

Rio de Janeiro,
Oct. 22, 1931.

Land Drainage in Minnesota

Sir—The author of the article in your issue of Dec. 10, entitled "Land Drainage in Minnesota Faces Financial Failure," could have made a more judicious choice of adjectives and superlatives without in any way detracting from the interest and value of his story. It is an exaggeration, to say the least, that a "majority of the projects" are an economic failure, unless the author means by this that all farming under present adverse conditions, whether on drained or undrained lands, is economically a failure. Only in the northern tier of counties, where wild unimproved peat marshes were drained on a large scale, can it be said that outstanding drainage bonds are seriously affecting the financial stability of the counties that have issued such bonds. In the southern three-fourths of the state, outstanding drainage bonds never have nor probably ever will be of serious concern to the counties. Tax delinquencies, however, constitute a serious problem in all of the communities, including localities that never have been affected by drainage bond issues.

Five of the total of 87 counties within the state have asked for relief to aid in meeting maturing drainage bond issues. These are all in the northern part. Other counties in this same section, but not materially affected by drainage, are facing just as serious situations as regards tax delinquencies. They too stand in need of relief unless more prosperous farming and business conditions speedily return.

The policy, or lack of it, that invited drainage and other forms of development of the northern peat-marsh areas has no defense. It placed on the tax lists hundreds of thousands of acres of unimproved lands, which, even at the peak of war-time prices of lands and farm products, were marginal. In times of the kind of depression that farmers now experience and have experienced for the past several years, when most efficient operators of the best lands find it difficult to "hang on," owners of unimproved peat marsh and cut-over lands that are far from markets and have to be cleared at great cost cannot hope to pay the excessively high taxes prevailing in our northern counties—drainage or no drainage—and survive. This situation, however, does not justify the placing of all of the blame for our financial ills on drainage, nor the sweeping statement that a majority of all of the drainage projects within the whole state of Minnesota are an economic failure.

Error due to lack of topographic maps and other studies that should have preceded our land-development program is fully admitted. The writer has been a persistent worker for these data during his whole professional career. But we need not use these handicaps to explain present conditions confronting owners and operators of drained lands. The costs of drainage became fixed charges at the time the projects were established and were payable, in Minnesota, in twenty years. These costs were incurred in time of $2.50-per-bushel wheat and $250-per-acre land and are being paid for in 60c.-per-bushel wheat and with lands at practically no market value. A per-acre cost of $35 in 1918 has become a $100 and greater per-acre expense, expressed in terms of the paying power of products and lands at today's prices. This is the picture, without shadings, of the situation that confronts the farmers operating drained lands under present most distressing circumstances. In this respect, however, payment of drainage investments made in the balmy days of high prices in terms of present values does not differ in any respect from payment of other forms of investments made during this same period on which deferred installments are becoming due during these times.

E. V. WILLARD,
Director, Division of Drainage and Waters, State of Minnesota.

St. Paul, Minn.,
Dec. 18, 1931.

Hydrologic Knowledge and Long Droughts

Sir—I am extremely interested in the paragraph headed "Extending Hydrologic Knowledge," p. 358 of your issue of Sept. 3, 1931, because as a worker in hydrological research I am delighted to learn of an accomplishment such as H. B. Lynch has achieved in southern California. Although at the present time there are few reports of this class, the publication of each such report will stimulate other hydraulic engineers to explore the records of other districts and thus add another brick or course to the temple of hydraulic research.

According to your remarks, Lynch has apparently discovered evidence that the recent recurrences of drought since 1920 in the United States, and I might also add in England, are neither so prolonged nor so severe as some of the visitations in the past. I can confirm these deductions. In view of the dense aggregations of people in industrial areas solely dependent on piped supplies, this evidence should stimulate water-supply and power authorities to make adequate provision for more prolonged and severe droughts and deficiencies than any recently experienced.

During the past four years, since coming to Australia to study drought and aridity, I renewed an investigation on drought. In the historical section of the investigation, data have been collected from historical chronicles, church, monastic, urban and manorial records, information on floods and drought being afforded by statements of high and low waters, notes on mills and fisheries, records of the prices of grain, salt and fish, thus giving some sort of a picture of the vagaries of the weather previous to the institution of rain gages.

A few rainfall records were made in Europe toward the end of the seventeenth century, but only a few have continued to the present time. There are fortunately a few records that have ranged over 150 years or more, including that at Cambridge, Mass. About 50, of which ten are in the United States, have been maintained for more than a century, and several hundreds have been maintained for periods from 50 years to a century. Many of the longer records will yield data on the duration of the periods of excess and deficiency as well as afford an indication of the duration of the period necessary to obtain a fairly approximate true mean.

The latter is not 35 years, as is commonly assumed; some records will give true means with a period as short as 25 years, others will give true means in 49, 64, 65 and 151 years. In one lengthy record 35-year periods selected at random differed from the true mean by as much as 12 per cent in defect and 11.8 per cent in excess; that particular record required observation for a period of 151 years in order to give a true mean, but means for 187 and 202 years differed by only 0.505 per cent from each other.

Droughts lasting from ten to thirteen years, although fortunately not common, have occurred over extensive areas at various times in different parts of the world. Some of the longer rainfall records reveal deficiencies that have lasted for 30 years or more. In one case a period of deficiency lasted with very minor breaks for 31 years, the maximum deficiency of that period being equivalent to 2.2 years' average rainfall.

There is a considerable store of information in the 848 years' continuous record of Nile floods on the Roda nilometer recorded by Arab historians, from which one deduces that there were single droughts lasting thirteen, eleven and ten years, two droughts each of eight and seven years' duration, five droughts of six years' duration, and nine droughts of five years' duration; between 761 and 794 A.D. there were four severe droughts lasting for eight, seven, five and four years, or aggregating 70.6 per cent of the whole period.

BALDWIN-WISEMAN,
University of Western Australia.

Perth, Australia,
Oct. 24, 1931.

NEWS OF THE WEEK

Obstacles Removed for San Gabriel Flood-Control Work

THE county board of supervisors of Los Angeles, Calif., voted on Jan. 13 to purchase for $125,000 seventy-four placer mining claims in San Gabriel canyon, the existence of which has been holding up preliminary work on the No. 1 dam. E. C. Eaton, chief flood-control engineer for the county, said that with the mining claims out of the way his department can complete within two weeks the preliminary engineering investigation. Work for 3,000 men on the construction of the dam is expected to be available by April 1.

Specifications have been adopted for the No. 2 dam of the revised San Gabriel flood-control plan by the Los Angeles County Flood-Control District and bids will be opened Feb. 8. The time allowed for preparation of bids for constructing this $3,000,000 rockfill dam has been reduced to a minimum to get the project under way quickly. The site is about 9 miles up the West Branch above the abandoned Forks site and has been approved by a consulting board, which recommended a rockfill type of dam. The work will involve 437,000 cu.yd. of excavation and 1,200,000 yd. of fill. Cash on hand will permit this work to begin without awaiting disposal of bonds.

Rains Bring Drought Relief to Southeastern States

Widespread rains over the entire Southeast at frequent intervals since early December have entirely relieved, at least for the present, the serious water shortage for domestic and industrial use and for hydro developments. Nearly all the numerous great hydro-electric storage reservoirs in that section of the country now are at or above normal stages for this period of the year. Streams leading into most of them also are so flush that the power developments which they serve can carry the loads on the power systems without any steam plant reserves being used. At the same time pond stages in most of these reservoirs are being raised. Whether the groundwater reserves of the Southeast, which have been so seriously depleted by two years of unusual drought, have been replenished adequately remains to be seen.

Salt Lake City's Waterworks Engineer Transferred

A change involving the transfer of the engineer of waterworks from the city engineer's office to the department of waterworks is announced by the city commissioners of Salt Lake City, Utah. R. C. Towler, who for a number of years has been waterworks engineer in the city engineer's office, now becomes associated with the waterworks department in a similar capacity.

In connection with this new arrangement it is announced that all future construction work of the water department, such as building pipe lines and reservoirs, will continue to be handled by the city engineer's office, but matters connected purely with the water department will be taken care of by that department.

Entire Road Program of Indiana County Abandoned

The board of county commissioners at South Bend, Ind., has abandoned the entire road program that was planned for 1932. The board justified its action by announcing that $150,000 will be saved and taxes reduced one cent on each $100 valuation.

Quebec Legislature Opposes St. Lawrence Development

Opposition to the development of the St. Lawrence River for power and navigation is expressed by the Quebec legislature in a resolution adopted by a vote of 54 to 7 on Jan. 14. Adoption of the resolution followed active discussion in which Premier Taschereau stated that the people of Quebec were opposed to taxing themselves to develop power which they did not need or to build a navigation canal which will ruin the railroads of the country.

Negotiations looking toward a treaty between United States and Canada are making good progress, according to reports from Ottawa. The dominion government is stated to have conceded to the province of Ontario complete jurisdiction over the development of power.

Segregation of Public Works Approved by Engineering Council

CONSOLIDATION of government construction work in an administration of public works, as proposed in the Cochran bill, was indorsed by the assembly of the American Engineering Council Jan. 15 after discussion resulted in withdrawal of an amendment that would have disqualified any officer of the army or navy on the active or retired list from serving as administrator, director or head of any bureau in the new organization. A proposal that river and harbor work should be reserved to the Army Corps of Engineers also was withdrawn on a showing that the President's recommendation to Congress embraced the transfer of this function of the Engineer Corps.

Scope enlarged

Probably the most important of amendments to the Cochran bill recommended in the report of council's public affairs committee was that specifically including within the scope of the administration of public works the design, construction, maintenance, operation and repair of ferries, boats, hospitals, lighthouses, prisons, storehouses, docks and flood-control works. The Cochran bill refers to all public buildings and public works, including railroads, highways, roads, bridges, telephone and telegraph lines, monuments, memorials, parks and grounds, irrigation and drainage systems, water-supply systems, dams, canals, and river and harbor improvements.

By amendment from the floor the Commission of Fine Arts was struck from the list of government agencies that, by specific provision, would be placed under the jurisdiction of the administration of public works. A proviso that nothing in the bill should be construed to affect the jurisdiction or authority of the comptroller general of the United States was deleted. In designating the bureaus under the interior department that should be transferred to the public works administration, the General Land Office was eliminated from the list that includes the Geological Survey, the Reclamation Service and the National Park Service.

Suggested lines of action for achieving economic balance were presented for discussion in a tentative report by R. E. Flanders, chairman of a special committee that has been studying the relation of production, distribution and consumption. The committee indorsed continuous studies of the economic situation by a permanent advisory council.

The assembly decided that the council should not affiliate with the Construction League of the United States but suggested that the American Society of Civil Engineers should consider establishing such a contact. On the recommendations of its committee charged with studying the engineering features of the report of the Garfield commission on the public domain, the assembly voted to take no action either opposing or favoring the report as a whole but that council should direct its attention to legislation relating in whole or in part to this subject and support or oppose bills introduced according to the policies already established by council in dealing with legislative matters of this kind.

Lee elected president

William S. Lee, president of the W. S. Lee Construction Co. and vice-chairman of the Duke Foundation, was elected president of council. Other officers include as vice-presidents L. B. Stillwell and R. C. Marshall, Jr., both of New York; treasurer, Farley Osgood, of New York. In his inaugural address, Mr. Lee made a plea that consideration be given to building up an endowment fund to support council activities. He pointed out the reduction in council's income, due to the depression, at a time when support is most needed.

South Carolina Notifies Road Contractors of Fund Shortage

Because of its inability to market additional bonds under the terms of the 1929 bond act, the state of South Carolina has found it necessary to restrict its payments on road work to keep within the funds on hand as they may be augmented by current revenues. A notice to this effect has been sent to all contractors on highway work, with the suggestion that the contractors adopt either of two courses: (*a*) that the work be continued without interruption and with the understanding that regular monthly estimates will be prepared and certified by the engineer and turned over to the contractor, payment to be made when funds are available either from the sale of additional bonds or accumulated revenues; or (*b*) that the contractor suspend operations, on conditions to be approved by the department, until notified by the department that funds are available for meeting his construction estimates as they may be earned.

This notice was sent out at the close of the year and the majority of the contractors have signified their intention of going forward with the work under contract.

New Honorary Members of the American Society of Civil Engineers

HONORARY membership was conferred upon four distinguished members of the American Society of Civil Engineers at the opening of its annual meeting in New York on Jan. 20. The men so honored are George W. Kittredge, Daniel W. Mead, George H. Pegram and Palmer C. Ricketts. Their election to honorary membership, which took place at the fall meeting of the board of direction at St. Paul, brings the list of honorary members of the society to eighteen.

George H. Pegram, chief engineer of the Interborough Rapid Transit Co. and the Rapid Transit Subway Construction Co., of New York City, was born at Council Bluffs, Iowa, Dec. 29, 1855, and was graduated from Washington University in 1877 at the head of his class. Mr. Pegram's experience in the civil engineering field covers a period of 54 years, most of it in railroad work. His first professional work was on the construction of the Utah & Northern Railway, now part of the Oregon Short Line, in Idaho. The Missouri Pacific Railway retained him as its consulting engineer in 1889, and in 1893 he became chief engineer of the Union Pacific system. His long association with New York City's transportation line dates from 1898, when he became chief engineer of the Manhattan Elevated Railway. He was made chief engineer of the Interborough Rapid Transit Co. and of the Rapid Transit Subway Construction Co. in 1905. Among important works credited to him are the design of the Kansas City Elevated Railroad, in which the use of cross-ties was eliminated, and that of the trainshed of the Union Terminal Station at St. Louis. He became a member of the American Society of Civil Engineers in 1883, and was a director in 1902-1904, vice-president in 1909-1910, and president in 1917.

Daniel W. Mead, professor of hydraulics and sanitary engineering, University of Wisconsin, was born in Fulton, N. Y., in 1862 and was graduated from Cornell University in 1884. His active engineering practice has been largely in the design and construction of waterworks in the central part of the United States and on irrigation projects in the West. He has held the chair of hydraulic sanitary engineering at the University of Wisconsin since 1904, but his university duties have not precluded service as chief engineer and consulting engineer for a large number of hydro-electric and waterworks plants. From 1913 to 1920 Mr. Mead served as consulting engineer for the Miami Conservancy District.

Palmer C. Ricketts, president of Rensselaer Polytechnic Institute, Troy, N. Y., was born in Elkton, Md., Jan. 17, 1856, and was graduated in civil engineering from Rensselaer Polytechnic Institute in 1875. He immediately became an instructor in his alma mater, was appointed director at the Institute in 1892 and was made president in 1901. Besides being director and president, he is also professor of mechanics in the Institute. In addition to his work with the Institute he has served as bridge engineer and consultant on numerous engineering projects. Dr. Ricketts was a director of the American Society of Civil Engineers in 1899-1901 and vice-president in 1916-17.

George W. Kittredge was born in North Andover, Mass., Dec. 11, 1856, and was graduated from Massachusetts Institute of Technology in 1877. For a short time after graduation he was in private practice in Boston, then, in 1880, he went with the Pennsylvania lines west of Pittsburgh, where he remained until in 1890 he became assistant chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis Railroad and a year later became chief engineer. This position he held until he was appointed chief engineer of the New York Central & Hudson River Railroad, now part of the New York Central Lines, in 1906. This position he held until in 1927, when he retired, having reached the age of 70 years. Since 1913 Mr. Kittredge has served as valuation engineer and consulting valuation engineer to the New York Central Lines. Mr. Kittredge was a director of the American Society of Civil Engineers in 1908-1910 and vice-president in 1917-18.

New York Building Code Ready for Approval

The final draft of the proposed new building code for New York City was turned over to the mayor on Jan. 14 by the Merchants Association of New York, whose special committee and its numerous subcommittees have spent three years in the revision of the 1915 code. The code to become effective must now be approved by the board of aldermen and signed by the mayor.

Dallas Approves Building of Sewage-Disposal Plant

Plans for the proposed sanitary sewage-disposal plant for the city of Dallas, Tex., which is to cost about $1,500,000, have been approved by the citizens' supervisory committee. The cost of the plant is to be paid from a bond issue voted two years ago, but work cannot be started until the city finds funds to meet interest and sinking fund charges on the bonds to be issued. Next year's budget is expected to provide this revenue.

George H. Pegram

Daniel W. Mead

Palmer C. Ricketts

George W. Kittredge

T. H. MacDonald First Recipient of G. S. Bartlett Award

Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads for the last twelve years, was presented with the newly established George S. Bartlett award at the opening session of the annual meeting of the American Road Builders' Association in Detroit last week.

©Harris & Ewing

This award, from funds contributed by friends of Mr. Bartlett, was created jointly by members of the American Association of State Highway Officials, the American Road Builders' Association and the Highway Research Board, and has the twofold purpose of honoring Mr. Bartlett and also of honoring annually some individual whose interest in highways has been of national benefit.

Mr. MacDonald's professional life has been devoted entirely to the cause of better highways since his graduation from Iowa State College in 1904. In that year he began as an assistant in the newly created Iowa state highway commission and shortly after became chief engineer of the commission, a position which he held for fourteen years. Since 1919 he has been chief of the U. S. Bureau of Public Roads, and under his leadership the bureau has become one of the most efficient agencies of the federal government.

The Bartlett award consists of a bronze wall plaque which bears a portrait head of Mr. Bartlett. It carries the inscriptions "George S. Bartlett Award" and "For outstanding contribution to highway progress."

Mr. Bartlett, who has been identified with the portland cement industry for the last 43 years, advocated the paving of rural roads about the time it was first seen that the automobile was to enter seriously into the country's economic life. He is a member of the staff of the Portland Cement Association.

Engineers' Relief Committee Set Up in Boston

An unemployment relief organization for engineers of the Boston metropolitan district known as the Emergency Planning and Research Bureau, Inc., has been established by the engineering societies of Boston. Thirteen societies and local sections of national societies are represented. Dougald C. Jackson is chairman of the finance committee.

A survey of unemployment among engineers in the district has shown that about 1,000 engineers, both members and nonmembers of the participating organizations, are out of work. The bureau will endeavor to provide relief for all in need of immediate help regardless of society membership.

In addition to finding work the bureau is asking all employed engineers to contribute one day's pay a month for five months. It also seeks contributions from concerns that are large employers of engineers. Through arrangements with the United Boston Relief Campaign Committee all contributions to the bureau's funds will be credited as contributions to the general relief campaign.

Herbert S. Crocker Elected President of Civil Engineers

Herbert S. Crocker, consulting engineer, of Denver, Colo., has been elected president of the American Society of Civil Engineers for the year 1932. Announcement of the election of Mr. Crocker was made at the opening of the annual meeting of the society in New York Jan. 20.

Mr. Crocker is a native of Haverhill, N. H., and a graduate of the University of Michigan in the class of 1889. In the years immediately following his graduation he was first a draftsman in the bridge-building department of the Chicago, Milwaukee & St. Paul Ry., than an assistant engineer in the office of the bridge engineer for the Northern Pacific Ry., an assistant engineer on structural iron works for the L. Schreiber & Sons Co., bridge engineer for the Toronto, Hamilton & Buffalo Ry. in charge of the construction of all steel structures between Hamilton and Welland, and then assistant engineer for the Lassig Bridge & Iron Works of Chicago, having oversight of the shop work on the steel for the Sanitary District of Chicago. In 1896 Mr. Crocker went to Denver to become assistant engineer of the board of public works and since that time, except for the time during and immediately following the war, has made his home there. Mr. Crocker remained with the department of public works until 1907, when he went into private practice.

Herbert S. Crocker

In 1917 Mr. Crocker was commissioned a major in the Engineer Corps and assigned to the army supply base in Brooklyn as the construction quartermaster. The following year he was promoted to the rank of lieutenant colonel in the Quartermaster Corps. Following his discharge from the army, Col. Crocker was for a short time in consulting practice in New York City as a member of the firm of Crocker & Crowell. From January, 1920, until May, 1921, he served as acting secretary of the American Society of Civil Engineers, returning to Denver in 1921 to resume private practice. In addition to his service in the society as acting secretary, he served as a director from 1915 to 1917 and as a vice-president in 1919 and 1920.

Vice-presidents and directors

Announcement of the election of the following vice-presidents and directors also was made at the annual meeting of the society: vice-presidents, to serve two years, Arthur S. Tuttle, consulting engineer to the board of estimate and apportionment of the city of New York, and David C. Henny, consulting engineer, Portland, Ore.; directors, to serve three years, Edward P. Luper, of Buffalo; John H. Gregory, Baltimore, Md.; Henry E. Riggs, Ann Arbor, Mich.; Melvin L. Enger, Urbana, Ill.; Robert Hoffmann, Cleveland, Ohio, John C. Stevens, Portland, Ore., and Ernest B. Black, Kansas City, Mo.

Prizes awarded

Presentation of the society's prizes and medals followed the conferring of honorary membership, noted elsewhere. The Norman medal was awarded to Floyd A. Nagler and Albion Davis for their paper on "Experiments on Discharge Over Spillways and Models at Keokuk Dam." John R. Freeman received the J. James R. Croes medal for his paper on "Flood Control on the Po River in Italy," and the Thomas Fitch Rowland prize and the Rudolph Hering medal were awarded to Samuel A. Greeley and William D. Hatfield for their paper on the "Sewage-Disposal Works of Decatur, Ill." The Arthur M. Wellington prize was awarded to George F. Schlesinger for his paper on "The Practical Utility of Highway Transport Surveys." No award was made of the James Laurie prize nor of the Collingswood prize for juniors.

No news of board action

No announcement was made of the action taken by the retiring board of direction at its meetings on Monday and Tuesday, as much of its action depended upon the action to be taken by the new board when the budget comes up for consideration on Thursday.

Reclamation Bureau Favors Columbia Basin Project

The feasibility of the Columbia Basin project depends upon the demand for power, according to a report submitted to the secretary of the interior by Elwood Mead, commissioner of reclamation. The area to be irrigated is, according to Commissioner Mead, the largest and finest body of unreclaimed land in the United States. Its reclamation is feasible if the cost of irrigation work exclusive of any part of the dam and power plant is repaid without interest over a period of 40 years, one-half to be repaid from surplus power revenues and the remainder as construction charges by landowners. As the power users will be called upon to pay half the cost of the irrigation work under this plan of financing, irrigation development, according to the Reclamation Bureau, should be deferred until the completion of the dam and power plant. The whole undertaking, therefore, hinges on whether a demand for power can be developed.

No justification for either the power or the irrigation project was found by the district engineers of the army in a report abstracted in our news pages last week.

Changes in Federal Wage Law Proposed by General Contractors

Engineering News-Record Staff Report

FOUR proposed changes in the Bacon-Davis prevailing wage law were approved by the Associated General Contractors at the opening of their thirteenth annual convention held in Milwaukee Jan. 18-22. Four hundred members were present at the opening of the convention.

The association will work for the following changes in the Bacon-Davis law: Extend the act to include all federal public works; have prevailing wages determined by the contract officer and stated in the call for bids; include a provision that the wages so stated must be paid; changes in wage scales ordered by the contract officer must result in a corresponding refund to the government or increase in compensation to the contractor depending upon whether the scale is lowered or raised; require that contractors guilty of underpayment or of demanding rebates from workmen pay to the workmen the amount due them, also permit the government to withhold amounts due or to sue in the civil courts for funds with which to pay workers the correct amount. In the latter case, if necessary, the government would be authorized to collect a penalty of $5 a day for each infraction.

The association registered strenuous objection to the proposal of Representative Goss to stop bid peddling by requiring contractors to file a list of their subcontractors with their own bids. The association declares that such a law would be difficult to enforce and would offer no protection to the general contractor against the raising of prices by subcontractors after the general contractor's bid has been accepted.

The association went on record as backing the Cochran bill to establish an administrator of public works and reiterated its stand of a year ago deploring gas tax diversion.

St. Paul Citizens Vote Down New Franchises for Utilities

NEW franchises for the Northern States Power Co. were voted down by the citizens of St. Paul, Minn., at a special election held on Jan. 12. Three franchise ordinances were voted upon, one for light and power, one for gas, and one for steam heat. The franchises lost by a vote of five to one. They did not carry a single precinct in the city.

The Northern States Power Co. has operated under a 25-year franchise which expired Feb. 4, 1931, under which it dispensed electric current and steam heat. A few years ago the company bought the St. Paul Gas Light Co. and its franchise expired Jan. 1, 1931.

The franchises which were submitted to the people were claimed to be the best contract that the city council could get. As first drawn by the city legal department they provided for continuing the 5 per cent gross-earnings tax, which last year brought in $383,000. They also provided for the complete valuation of the company's property for rate-making purposes. This latter provision was included because of a feeling that rates are too high. This feeling is accentuated by the fact that many manufacturing plants produce their own electric current because they can do so cheaper than they can buy it from the Northern States Power Co. The company refused to accept the contracts drawn by the city unless the 5 per cent gross-earnings tax was eliminated and the revaluation of its plant was postponed until 1940. It agreed that if the franchise was carried rates in St. Paul and Minneapolis would be on a parity, otherwise the charter amendment or franchise provided that the company is entitled to rates and profits which will earn for it no more than a "reasonable rate" on its "tangible property."

A number of years ago the power company introduced "customer ownership" and sold preferred shares in the Northern States Power Company of Delaware to 11,400 residents of St. Paul.

The Northern States Power Company of Minnesota is a subsidiary of the Delaware company, which is a subsidiary of the Standard Gas & Electric Co., owned by the Standard Power & Light Corp. and controlled by the United States Electric Power Corp. and H. M. Byllesby & Co.

A stockholders' committee was formed in St. Paul to work for the franchise, and a number of able speakers made a determined campaign to put the franchise over.

At the election 51,900 ballots were cast 42,508 in opposition and 8,760 for the franchise. The total number of registered voters in St. Paul is 95,801.

The 5 per cent gross-earnings tax is looked upon by the city as a license fee for the use of public streets, but it also reduces taxation by that amount. If the franchise had passed, the city would have been obliged to add $383,000 to taxation, and the people were in no mood, especially the small home owners to have their taxes raised. On the other hand, the promise of the electric company that it would voluntarily reduce electric rates to the amount of $240,000 was not regarded as sufficient inducement because of the small cut on each bill. Furthermore, it was shown that the gross-earnings tax, while $383,000 now, might amount to $1,000,000 before the twenty-year term expired.

Because of the failure of the franchises to pass the commissioner of public utilities has asked the corporation counsel to draw up a temporary permit for one year.

Massachusetts Council May Lose Power to Approve Contracts

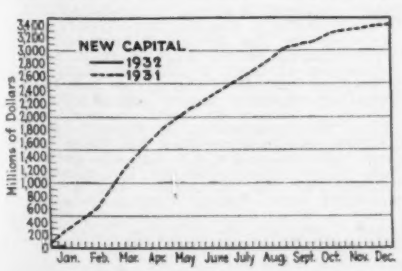
As a result of the controversies over awarding state highway contracts in Massachusetts, State Senator Ulin has introduced a bill in the legislature designed to take away from the executive council its power of approval of road contracts and vest it in the state commission on administration and finance.

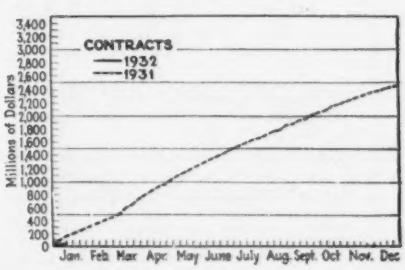
Many road contracts in the state are held up because of the refusal of the executive council to approve awards to the lowest bidder unless the lowest bidder is a Massachusetts concern.

Capital and Contracts

New construction financing during the week ended Jan. 16 totaled $5,000,000—two municipal bond issues and one state issue. Private financing for construction has been absent from the market since the beginning of the new year. The total for the preceding week was $3,000,000 and that for the corresponding week of 1931, $81,000,000.

Cumulative new-capital issues for 1932 amount to but $8,000,000, compared with $162,000,000 in the 1931 period.





COSTS AND CONTRACTS

ENR Index Numbers

	Cost		Volume	
Jan. 1,	1932 162.48	Dec.,	1931	133
Dec. 1,	1931 166.23	Nov.,	1931	180
Jan. 1,	1931 194.48	Dec.,	1930	192
Average,	1931 181.35	Average,	1931	220
Average,	1930 202.85	Average,	1930	260
1913	100.00	1913		100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Jan. 21, with some comparisons, total as follows:

(In Thousands of Dollars)

	Jan. 21, 1932	Average of Last Four Weeks 1932-31	1931
Buildings:			
Industrial	$1,500	$1,769	$3,216
Other	5,255	9,194	16,298
Streets and roads..	2,726	2,577	7,049
Other construction.	7,478	8,493	23,611
Total	$16,959	$22,034	$50,175

Total, all classes, Jan. 1 to Jan. 21:
1932 ..... $68,140
1931 200,703

Brief News

NET PROFIT from tolls on the Delaware River bridge in 1931 was $3,048,981. During the year 12,308,022 vehicles crossed the span.

ISSUANCE OF BONDS totaling $1,000,000 for road and school construction in 1932 has been authorized by the commissioners of Montgomery County, Maryland.

A DEFICIT of $1,347,661 is reported by the Detroit & Canada Tunnel Co. for the first nine months of 1931, and on the basis of these figures the net loss for the full year is estimated at $1,500,000.

FOR THE THIRD SUCCESSIVE YEAR not a single outbreak of typhoid fever or other water-borne disease which could be attributed to the use of public water supply has occurred in the State of New York.

PUBLIC WORKS and undertakings for the province of New Brunswick, involving a total cost of $1,874,000, have been approved by the federal government. The dominion contribution toward the cost of these works, because they are being carried out largely as unemployment relief measures, is $724,475.

PART-TIME HEALTH SERVICE will be overcome eventually in cities in New York State with more than 50,000 population by the new law which requires that in such cities health officers hereafter appointed shall devote full time to the duties of the office and shall not engage in the practice of medicine.

A CONTRACT has been awarded by the government of Honduras to the W. B. Watters Co., Columbus, Ohio, to build 200 miles of railroad in that country at a cost of about $8,000,000. The new railroad will supplement the present line, 70 miles long, known as the National Railway, and will extend from the present terminus of the line to Amapala on the Gulf of Fonseca.

Personal Notes

JOHN F. DONOVAN, since December, 1927, city manager of Auburn, N. Y., has been elected city manager of New Rochelle, N. Y.

ELLIOT J. DENT, colonel, U. S. army, who has been servng with the 13th Engineers at Fort Humphreys, has been made district engineer of the Baltimore engineer district.

EDGAR A. VAN DEUSEN, who for the past 25 years has been identified with public utilities and consulting engineers in various engineering and management capacities, has opened a consulting office in New York and will specialize in a "library research service" for engineers and contractors, architects, trade and civic associations, public utilities and manufacturers.

GEORGE S. BLOOMGREN, for the last five years assistant city engineer of East Liverpool, Ohio, has been appointed city engineer to succeed FLAY CLAPSADDLE, who has resigned. Mr. Bloomgren is a graduate of the engineering school of the Ohio Northern University and was connected with the Pennsylvania state highway department before going to East Liverpool. The office of assistant city engineer has been abolished.

L. G. LENHARDT, assistant engineer, Detroit department of water supply and former assistant city manager of Pontiac, Mich., has succeeded Joseph E. Mills as head of the Detroit department of public works. Mr. Mills has been transferred to the management of the street railway system.

H. S. COMLY, of Redding, Calif., and F. W. HASELWOOD, of Eureka, Calif., district engineers of the California division of highways, will exchange positions on Feb. 1. The change is made because each engineer is more specialized in the future work in the respective districts.

WILLIAM G. CLARK, consulting engineer, Toledo, Ohio, has been made water commissioner, succeeding A. Carle Rogers.

CLARENCE E. WILD has been appointed city engineer of Akron, Ohio, replacing E. A. KEMMLER, bureau of highways engineer, and A. B. BACKHERMS, bureau of sewage engineer. Mr. Wild has been engineer of division No. 4, state highway department.

HARVEY SLOCUM, general superintendent of construction of Madden Dam, has resigned. It is announced that the reason for his resignation is that his wife's health does not permit her to live in the Canal Zone.

Obituary

JOHN J. RUPP, head of the Rupp Excavating Co., of Buffalo, N. Y., and an authority on bedrock, died on Jan. 9.

HARRY T. WATTS, formerly city engineer of Vincennes, Ind., died recently in that city. He was 57 years old.

FRANK N. FARRAR, former president of the Builders Exchange of Buffalo, N. Y., and until Oct. 1 secretary of the exchange, died on Jan. 12 after a lingering illness. Mr. Farrar, who was 71 years old, was also a member of the board of control of the National Association of Builders Exchanges.

MAX TOLTZ, of the firm of Toltz, King & Day, consulting engineers and architects, St. Paul, Minn., died Jan. 11. Mr. Toltz was 75 years old. He was born in Germany and was educated at the Royal Academy of Science and Engineering, Berlin. Prior to entering the consulting field, Mr. Toltz was connected with railroad development in the Northwest—with the Great Northern, Canadian Pacific, Northern Pacific, and Butte, Anaconda & Pacific. He was a member of the American Society of Civil Engineers and the American Society of Mechanical Engineers and was a representative on Engineering Council of the A.S.M.E.

SOCIETY CALENDAR

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; annual meeting, Jan. 19-22, New York City.

AMERICAN WOOD PRESERVERS' ASSOCIATION, Chicago; annual meeting, St. Louis, Jan. 26-29.

ENGINEERING INSTITUTE OF CANADA, Montreal; 46th annual meeting, Toronto, Feb. 3-5.

NATIONAL PAVING BRICK ASSOCIATION, Washington; annual meeting, Chicago, Feb. 10-12.

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington; annual meeting, Pittsburgh, Jan. 27-29.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold a third regional meeting in Cleveland on March 9. The technical feature of the meeting will be a symposium on rubber products.

ENGINEERING COUNCIL OF UTAH at a recent meeting in Salt Lake City elected as its president Dorsey A. Lyon, director of the Utah engineering experiment station at the University of Utah. Dr. Lyon is also president of the Utah Society of Engineers. Other officers elected were: vice-president, C. T. Van Winkle; secretary-treasurer, George M. Bacon (reelected).

ENGINEERS CLUB, Birmingham, Ala., has elected the following officers: president, W. G. Stromquist; vice-president, J. W. Orcutt; secretary-treasurer, Guy Freeman.

INDIANAPOLIS ENGINEERING SOCIETY has elected officers for 1932 as follows: president, Emmett G. Fowler; vice-president, Wayne W. Templeton; secretary, Daniel B. Luten; treasurer, H. F. Osler.

MARYLAND-DELAWARE WATER AND SEWERAGE ASSOCIATION will hold its sixth annual conference in Cumberland, Md., April 12-13.

MARYLAND SECTION, American Society of Civil Engineers, announces that the prize of $25 for the best paper written by one of its junior members during 1931 has been awarded to Harry J. Engel, of Baltimore, for his paper "Structural Features of Airplane Wing Design."

MASSACHUSETTS SAFETY COUCIL has elected the following officers: president, John H. Sherburne; vice-president in charge of public safety, Philip L. Schuyler; vice-president in charge of industrial safety, Luther R. Harris; vice-president in charge of home and school safety, Carl L. Schrader; vice-president in charge of fire prevention, Alfred N. Miner; treasurer, Thomas P. Beal; general manager, Lewis E. MacBrayne.

NATIONAL RIVERS AND HARBORS CONGRESS has been formally incorporated, and the articles of incorporation have been filed with the recorder of deeds of the District of Columbia. The incorporators are: Clayton F. Moore, clerk of the ways and means committee of the House of Representatives until the control of Congress changed; William H. Webb, formerly clerk of the committee on flood control; and J. Frederick Richardson, publicity man for the Rivers and Harbors Congress.

NORTH CAROLINA SOCIETY OF ENGINEERS at its midwinter meeting in Raleigh elected as president C. W. Smedburg, director of public works of the city of Greensboro. W. J. Dana, professor of experimental engineering at the North Carolina State College, was chosen vice-president.

PROVIDENCE ENGINEERING SOCIETY at its sixteenth annual banquet on Feb. 2 will have as its principal speaker John M. Carmody, editor of *Factory and Industrial Management* and president of the National Society of Industrial Engineers, who recently completed a 10,000-mile trip through Russia. Mr. Carmody will speak on "Russia and the Five-Year Plan."

WEST SHORE WATER PURIFICATION CONFERENCE was the name tentatively selected for the group of operators of water plants on the west shore of Lake Michigan at their meeting at Kenosha, Wis., on Jan. 13. The group has been meeting monthly since last April, to discuss common problems in purifying Lake Michigan water. No formal organization has been adopted but three officers were selected at the Kenosha gathering to be responsible for the arrangements for the meetings. The officers selected were: W. A. Peirce, chairman, Racine, Wis.; P. J. Hurtgen, vice-chairman, Kenosha, Wis.; George B. Prindle, secretary, Highland Park, Ill.

Trucks and Materials Dominate Road Show

Eighteen truck manufacturers display 65 models at Detroit. Materials and equipment for bituminous roads prominent

Engineering News-Record Staff Report

THE 1932 Road Show, held at the Detroit municipal airport, Jan. 11-15, lacked the grandeur and massiveness of its predecessors, at Chicago, Cleveland, Atlantic City and St. Louis. Gone were the huge shovels and excavators of former years; gone was every semblance of a concrete mixer; gone were most of the dirt-moving scrapers and graders; a single air compressor replaced the battery of noisy displays of its class previously present. It was a truck and bituminous equipment and material show. A large share of the floor space was taken up by 65 trucks and trailers displayed by eighteen manufacturers. Bituminous road materials and equipment were shown by 25 firms. The burden of pushing concrete roads was left to aggregate-batcher, screed-machine, concrete-curing and expansion-joint displays.

While the 1932 Road Show lacked the visual appeal of its predecessors because of the absence of displays of large equipment, it equalled or surpassed them in solid technical merit, as for example in the fund of information that was available on modern road materials and their proper methods of use.

In the 233 exhibits there was very little new and revolutionary equipment. A new bituminous road-making machine was announced, but not shown. Two new garbage trucks were displayed. One road roller appeared with a crawler rear-end attachment for easy conversion into a tractor. A pulled road grader with a tubular frame attracted considerable interest. In the truck exhibits was noticeable a tendency of manufacturers to create models especially suited to construction. The largest single piece of equipment shown was a new portable asphalt-patching plant. An all-aluminum wheelbarrow was lifted by many visitors at the show.

Many of the special exhibits such as those of the U. S. Bureau of Public Roads and the highway departments of Michigan, Ohio and New Jersey were both interesting and educational.

A summary of exhibitors and their displays is given in the following:

ABRAMS AERIAL SURVEY CORP., Lansing, Mich.; aerial survey service.

AEROIL BURNER CO., West New York, N. J.; bituminous heating and spraying equipment; concrete heaters; weed burners.

ALUMINUM COMPANY OF AMERICA, Pittsburgh; aluminum wheelbarrow, shovels, truck bodies, shapes, concrete surfacer, pavement tester.

AMERICAN BITUMULS CO., San Francisco; Bitumuls road material.

AMERICAN CABLE CO., Bridgeport, Conn.; wire rope and fittings.

AMERICAN FORK & HOE CO., Cleveland; hand shovels, spades, scoops.

AMES BALDWIN WYOMING SHOVEL CO., North Easton, Mass.; hand shovels, spades, scoops.

AMIESITE ASPHALT COMPANY OF AMERICA, Philadelphia; Amiesite road material.

AMPLEX DIVISION OF CHRYSLER MOTOR CO., Detroit; industrial gas engines.

ANTHONY CO., Streator, Ill.; dump truck bodies.

ARMCO CULVERT MFRS. ASSN., Middletown, Ohio; multiplate (large-diameter) corrugated iron culvert pipe, metal cribbing, paved invert pipe.

ASPHALT INSTITUTE, New York, N. Y.; road materials.

AUTOMATIC SIGNAL CO., New Haven, Conn.; traffic-actuated signals.

AMERICAN CURB & GUTTER BLOCK CO., New York; machines for making precast curb and gutter units.

ATHEY TRUSS WHEEL CO., Chicago; crawler units.

BARBER ASPHALT CO., Philadelphia; Trinidad and Bermudez lake asphalts and Curcrete (for concrete curing).

BARBER-GREENE CO., Aurora, Ill.; description of new bituminous road plant.

BARRETT CO., New York; Tarvia road material.

C. F. BATTENFIELD OIL CO., Detroit; lubricants.

BAY CITY SHOVELS, INC., Bay City, Mich.; full-revolving shovel, ¾-yd.; 15-ton trailer.

BEACH MFG. CO., Charlotte, Mich.; plows, scrapers, snow fence, culvert pipe, crack filler, torch and models of snow plows and maintainers.

BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE CO., Pittsburgh; air brake truck installations.

BLACK & DECKER MFG. CO., Towson, Md.; electric drills and grinders; portable truck scales; sewer pipe tester.

BLAW-KNOX CO., Pittsburgh; 1-yd. controllable dump bucket; Ord finishing machine; aggregate-weighing batcher; cement-weighing batcher; road, street and walk forms; clamshell bucket; 4-yd. hydraulic scraper.

BRAGG-KLIESRATH CORP., South Bend; Timken and Bendix trailer power brakes; Timken trailer axles with power brake.

BROCKWAY MOTOR CO., Cortland, N. Y.; trucks.

BRODERICK & BASCOM WIRE ROPE CO., St. Louis; wire rope.

CHAS. BRUNING CO., INC., Detroit; Blackline plan printing machinery.

BUFFALO-SPRINGFIELD ROLLER CO., Springfield, Ohio; gas-powered rollers.

BUDA CO., Harvey, Ill.; diesel and gas engines and power units.

BURCH CORP., Crestline, Ohio; snow plows for trucks; stone spreader; crack filler; trench filler.

BURROUGHS ADDING MACHINE CO., Detroit; business machines.

BUTLER BIN CO., Waukesha, Wis.; model of three-compartment aggregate storage and weighing bin.

CAMBRIDGE CORP., Homewood, Ill.; pavement surface tester.

PHILIP CAREY CO., Cincinnati; Elastite expansion joint, rail filler, asphalt plank and subgrade felt.

CARNEGIE STEEL CO., Pittsburgh; T-Tri-Lok bridge floor construction; sheetpiling.

J. I. CASE CO., Racine, Wis.; industrial tarctors; power mower; industrial engines.

CENTAUR TRACTOR CORP., Greenwich, Ohio; self-propelled highway mower.

CENTRAL IRON & STEEL CO., Harrisburg, Pa.; traffic-tread plates.

CHEVROLET MOTOR CO., Detroit; trucks; one with Portland transit mix concrete body.

CLEAVER-BROOKS CO., Milwaukee; bituminus tank heaters and pump boosters.

COLAS ROADS, INC., New York; cold asphalt emulsions and Colas road products.

THOS. E. COLLINS & CO., St. Louis; enameled fabric road and warning signs.

COLPROVIA ROADS, INC., New York; Colprovia road material.

COLUMBIA ALKALI CORP., Barberton, Ohio; calcium chloride.

CONCRETE SURFACING MACHINE CO., Cincinnati; Berg concrete and highway surfacers and finishers; cleaning and grinding tools.

CONTINENTAL MOTORS CORP., Muskegon, Mich.; gas engines and power units.

CURTIS PNEUMATIC MACHINERY CO., St. Louis; portable air compressor units.

D-A LUBRICANT CO., Indianapolis; lubricants.

DIAMOND IRON WORKS, INC., Minneapolis; belt-drive crusher; road surfacer.

DODGE BROS. (Chrysler), Detroit; trucks, some with compressors, dump bodies, scrapers or snow plows; semi-trailer with van body.

DOW CHEMICAL CO., Midland, Mich.; Dowflake calcium chloride.

DUPLEX TRUCK CO., Lansing, Mich.; dump truck.

E. I. DU PONT DE NEMOURS & CO., Wilmington, Del.; blasting products.

EATON AXLE & SPRING CO., Cleveland; axles; heaters; valves and springs.

EISEMANN MAGNETO CORP., New York; magnetos.

ELECTRIC WHEEL CO., Quincy, Ill.; steel wheels.

E. D. ETNYRE & CO., Oregon, Ill.; asphalt and oil distributor tank for trucks.

EUCLID ROAD MACHINERY CO., Cleveland; 8-yd. bottom- and end-dump wagons on trailer crawlers; sheepsfoot roller; rotary and wheel scrapers.

FAIRBANKS, MORSE & CO., Chicago; concrete aggregate scales.

J. D. FARASEY MFG. CO., Cleveland; description of asphalt plants.

FAWICK MFG. CO., Waukesha, Wis.; clutches and power takeoffs.

FEDERAL MOTOR TRUCK CO., Detroit; trucks, one with eight powered rear wheels.

FLINTKOTE CO., Boston, Mass.; Flintkote asphalt emulsions, shingles, roofing, and preformed mastics (joints and planks).

FORD MOTOR CO., Detroit; trucks with dump bodies, stake body and contractors bus body.

FOUR WHEEL DRIVE AUTO CO., Clintonville, Wis.; garbage truck; road maintainer; truck chassis, tandem rear wheels.

FREEMAN QUADRIVE CORP., Pontiac, Mich.; four-wheel drive wrecking and service truck.

FRUEHAUF TRAILER CO., Detroit; stake, tank and van body trailers; 40-ton heavy duty trailer.

FULLER CO., Catasauqua, Pa.; Fuller-Kinyon portable bulk cement unloader; rotary gate valve for cement bins; rotary air compressor.

GALION ALLSTEEL BODY CO., Galion, Ohio; dump truck bodies.

GENERAL MOTORS TRUCK CO., Pontiac, Mich.; trucks, one with eight powered rear wheels.

GENEVA METAL WHEEL CO., Geneva, Ohio; steel wheels; roller bearings; axles; metal traffic markers.

GLEDHILL ROAD MACHINE CO., Galion, Ohio; pulled road grader.

W. S. GODWIN CO., INC., Baltimore; steel paving and curb guards.

GOROCO MECHANICAL SPREADER CO., Philadelphia; stone and sand spreaders.

GREENVILLE MFG. WORKS, Greenville, Ohio; trailer grits distributor.

HAISS MFG. CO., New York; description of loaders, concrete distributors, excavators and clamshells.

HAMILTON MFG. CO., Two Rivers, Wis.; drafting tables; stools; filing cabinets.

HANSON CLUTCH & MACHINE CO., Tiffin, Ohio, ¾-yd. gas shovel.

HARNISCHFEGER CORP., Milwaukee; P&H ¾-yd. gas shovel.

HAUCK MFG. CO., Brooklyn, N. Y.; asphalt surface heater; emulsion sprayer; weed burner; heating torch; concrete heater; asphalt plant burners; melting kettle.

HAZARD WIRE ROPE CO., New York; wire rope.

HEADLEY EMULSIFIED PRODUCTS CO., Philadelphia; emulsified asphalts.

HEIL CO., Milwaukee; models of hoists, truck bodies and tanks.

HELTZEL STEEL FORM & IRON CO., Warren, Ohio; mechanical screed and joint installer; road forms; cement-weighing plant; retread machine; model of aggregate-weighing bins.

HERCULES CO., Marion, Ohio; road rollers; crawler unit for converting roller to tractor.

HERCULES MOTORS CORP., Canton, Ohio; gas engines and power units.

HERCULES POWDER CO., Wilmington, Del.; blasting products.

HERCULES PRODUCTS, INC., Evansville, Ind.; mechanical, hydraulic, rotary and automatic dump bodies, trailer-type mechanical spreader; gas, kerosene and distillate engines.

HETHERINGTON & BERNER, INC., Indianapolis; one-unit portable asphalt patching plant.

HIGHWAY SERVICE, New Bedford, Mass. mechanical spreaders and Rol-roc rollers.

HI-WAY SERVICE CORP., Milwaukee; Drott mechanical bulldozer on crawler tractor.

HUPER MFG. CO., Marion, Ohio; gas road rollers; maintainer.

HUG CO., Highland, Ill.; roadbuilder trucks; spring blade agitator concrete truck body; subgrading machine; subgrade templet.

CHAS. HVASS CO., New York; bituminous distributors on trucks; trailer supply tanks; spreader attachments for trucks.

HYATT ROLLER BEARING CO., Newark, N. J.; roller bearings.

INDIANA MOTORS CORP., Marion, Ind.; dump trucks.

INTERNATIONAL HARVESTER CO., Chicago; tractors; dump trucks and chassis.

INTERNATIONAL MOTOR CO., Long Island City, N. Y.; Mack truck engines.

IOWA MFG. CO., Cedar Rapids, Iowa; crushers.

JEFFERSON CO., Hoboken, N. J.; illuminated road signs and signals.

JOHNS-MANVILLE CORP., New York; expansion joints; asphalt flooring; Celite; Transite asbestos and cement pipe.

C. S. JOHNSON MFG. CO., Champaign, Ill.; cement-weighing hopper.

KELLER TRACTOR & SHOVEL CO., Detroit; description of tractors.

KILLEFER MFG. CO., Los Angeles; ditching machine; road disk; scarifier; wheel scraper; revolving scrapers; road ripper.

KINNEY MFG. CO., Boston; 800-gal. asphalt heater and distributor on truck; rotary pump for unloading asphalt from cars.

KOHLER CO., Kohler, Wis.; gas-driven electric plants.

KOPPERS PRODUCTS CO., Pittsburgh; Tarmac road material.

LA FRANCE-REPUBLIC SALES CORP., Alma, Mich.; dump trucks.

LAKEWOOD ENGINEERING CO., Columbus, Ohio; concrete road finisher and screed; subgrader; grade rooter; form tamper.

LEADCLAD STEEL CORP., Columbus, Ohio; Leadclad corrugated culvert pipe, wire mesh, wire and sheet metal.

LEROI CO., Milwaukee; gas engines and power units.

A. LESCHEN & SONS ROPE CO., St. Louis; wire rope.

LIBBEY CATAPHOTE CORP., Toledo, Ohio; reflector signs, signals and buttons.

LINCOLN OIL REFINING CO., Robinson, Ill.; Lincolnite road material.

LINDE AIR PRODUCTS CO., New York; carbide and acetylene equipment; carbide lights; welding equipment.

LITTLEFORD BROS., Cincinnati; asphalt distributor; maintenance kettle; combination joint filler and line marker; emulsion sprayer; all-steel portable tool box.

LUFKIN RULE CO., Saginaw, Mich.; tapes, rules, precision tools and Crescent tape rule.

MACASPHALT CORP. OF AMERICA, New York; cold-laid asphaltic paving mixtures.

MAGNETIC NEON CORP., OF OHIO, Cleveland; flashing road signals.

MALL TOOL CO., Chicago; portable grinders, buffers, cleans and saws.

MALLEABLE IRON FITTINGS CO., Branford, Conn.; fittings for guard cable construction.

MARION STEAM SHOVEL CO., Marion, Ohio; description of shovels.

MICHIGAN POWER SHOVEL CO., Benton Harbor, Mich.; tractor-mounted ¾-yd. shovel, take-off powered; ¾-yd. tractor-mounted pull shovel.

MICHIGAN TOOL CO., Detroit; worm gearing; taps, cutters, etc.

MOON TRACK CO., Chicago; crawlers for tractors; Fabriform high loader, tractor mounted.

MOTOR IMPROVEMENTS, INC., Newark, N. J.; oil filters; air separators.

MUELLER CONCRETE CONSTRUCTION CO., Detroit; egg-shaped concrete pipe and equipment.

NATIONAL CARBIDE SALES CORP., New York; carbide lights; acetylene equipment.

NATIONAL PAVING BRICK ASSN., Washington; data on paving brick.

NATIONAL TRAFFIC GUARD CO., Atlanta; Resiliflex metal band highway guard rail.

N. P. NELSON IRON WORKS, Passaic, N. J.; data on snow loaders, excavators and cranes.

NORMA-HOFFMAN BEARINGS CORP., Stamford, Conn.; ball, roller and thrust antifriction bearings.

NOVO ENGINE CO., Lansing, Mich.; gas engines.

TINIUS OLSEN TESTING MACHINE CO., Philadelphia; balancing machine; shot-type cement tester; concrete beam tester; collapsible molds; road surface rater; Universal testing machine; ductility tester; Brinnel hardness tester; rubber hardness tester.

OWEN BUCKET CO., Cleveland; clamshell buckets.

PAGE STEEL & WIRE CO., Pittsburgh; traffic-tape guard rail; wire-mesh guard rail.

PERFECTION STEEL BODY CO., Galion, Ohio; hydraulic, mechanical and gravity dump bodies.

PERFEX CORP., Milwaukee; radiators and heating units.

PIERCE GOVERNOR CO., Anderson, Ind.; governors for gas engines; light gas road rollers.

PIONEER GRAVEL EQUIPMENT MFG. CO., Minneapolis; crusher; model of screening and crushing plant.

PNEU-HYDRO ROAD MACHINERY CO., Cadillac, Mich.; snow blades and road planers for truck attachment.

PORTLAND CEMENT ASSN., Chicago; data on concrete roads and streets.

QUAKER STATE OIL REFINING CO., Oil City, Pa.; lubricants.

R. B. EQUIPMENT MFG. CO., Detroit; fine-grading mechanical subgrader.

RELAY MOTORS CORP., Lima, Ohio; trucks, some with dump bodies.

REO MOTOR CAR CO., Lansing, Mich.; trucks.

RICHARDSON SCALE CO., Clifton, N. J.; Duo-Screw feed automatic cement scale.

W. A. RIDDELL CO., Bucyrus, Ohio; motor graders; drawn graders; crawlers for tractors; Octopus eight-wheeled pneumatic-tired traction unit.

ROCKFORD DRILLING MACHINE CO., Rockford, Ill.; clutches; Morse chain-drive.

ROOT SPRING SCRAPER CO., Kalamazoo, Mich.; hydraulic motor truck maintainer; models of snow plows.

ROSCO MFG. CO., Minneapolis; model of road oil distributor; chatter eliminator for scrapers.

ST. PAUL HYDRAULIC HOIST CO., St. Paul; models of hydraulic hoists and truck bodies.

SAT-UR-MIX CORP., Wooster, Ohio; Saturmix machine for coating aggregates with bitumen.

SAUERMAN BROS., Chicago; drag scraper; Durolite steel blocks; models of tautline, slackline and tractor dragline and conveying equipment.

SAWYER-MASSEY, LTD., Hamilton, Ont.; data on road machinery.

SCINTILLA MAGNETO CO., INC., Sidney, N. Y.; magnetos and ignition accessories.

SERVICISED PRODUCTS CORP., Chicago; asphalt planking, rail filler, expansion joint, plank tile and sponge rubber expansion joint.

SHUNK MFG. CO., Bucyrus, Ohio; Camel tractor-dump wagon; snow plows, road grader blades; metal and rubber traffic-lane markers.

SIGNAL SERVICE CORP., Elizabeth, N. J.; plain and reflector road signs.

SINCLAIR REFINING CO., New York; lubricants.

SISALKRAFT CO., Chicago; paper for curing concrete.

SKINNER MOTORS, INC., Detroit; Oil reclaimers.

SKOW ROTARY DISC SHARPENER CO.; disk sharpeners.

A. O. SMITH CORP., Milwaukee; steel highway-railroad crossing units.

SOLVAY SALES CORP., New York; calcium chloride.

SOUTH BEND LATHE WORKS, South Bend; lathes.

SPICER MFG. CO., Toledo; clutches.

SPLITDORF ELECTRICAL CO., Newark, N. J.; magnetos and ignition equipment.

STANDARD OIL CO. OF OHIO, Cleveland; lubricants; motor fuel; asphalt road oils.

STINSON AIRCRAFT CORP., Wayne, Mich.; cabin monoplane.

STOVER MFG. & ENGINE CO., Freeport, Ill.; gas engines.

STUDEBAKER-PIERCE ARROW CO., South Bend; trucks, some with dump bodies.

SUPERIOR CONSTRUCTION EQUIPMENT CO., Chicago; Banty roller and trailer.

SUPERIOR SHEET STEEL CO., Canton, Ohio; metal and reflector road signs.

TIMKEN-DETROIT AXLE CO., Detroit; axles.

TIMKEN ROLLER BEARING CO., Canton, Ohio; roller and thrust bearings.

TITE-FLEX METAL HOSE CO., Newark, N. J.; all-metal tubing and bendable pipe.

TOLEDO SCALE CO., Toledo, Ohio; aggregate-proportioning scales and equipment.

TONCAN CULVERT MFRS. ASSN., Youngstown, Ohio; copper-molybdenum iron culverts and drains; Tyton sluice gates.

TORO MFG. CO., Minneapolis; truck attached mower, gas driven.

TRACKSON CO., Milwaukee; tractors with crawlers; Trackson high shovel; 8-yd. crawler wagon.

TWIN-DISC CLUTCH CO., Racine, Wis.; clutches; power takeoffs; reduction gear units.

UNION STEEL PRODUCTS CO., Albion, Mich.; road-reinforcing mesh and accessories.

UNITED AMERICAN BOSCH CORP., Springfield, Mass.; magnetos.

U. S. OIL CO., Providence, R. I.; lubricants.

UNIVERSAL CRUSHER CO., Cedar Rapids, Ia.; model of crusher.

UNIVERSAL MOTOR CO., Oshkosh, Wis.; gas engines and gas-driven electric plants.

VALVOLINE OIL CO., Cincinnati; lubricants.

VELLUMOID CO., Worcester, Mass.; sheet packing and gaskets.

WALTER MOTOR TRUCK CO., Long Island City, N. Y.; trucks, one with Walter snow plows attached.

WARFORD CORP., New York; six- and eight-wheel units for Ford trucks, power on all rear wheels.

WAUSAU IRON WORKS, Wausau, Wis.; hydraulic and mechanical snow plows for trucks and tractors.

WAUKESHA MOTOR CO., Waukesha, Wis.; diesel and gas engines and power units; truck mixer motor.

WELLMAN ENGINEERING CO., Cleveland; Williams clamshell and dragline buckets.

WELSBACH TRAFFIC SIGNAL CO., Philadelphia; flashing road signals.

WESTERN METAL SPECIALTY CO., Milwaukee; sheet metal tanks and hoods.

WESTERN STAMPING & MFG. CO., Cleveland; metal and reflecting road signs; traffic markers.

WHITE CO., Cleveland; trucks, one with garbage body, one with eight powered rear wheels.

WIARD PLOW CO., Batavia, N. Y.; contractors' plows; grade ripper; scarifier.

WICO ELECTRIC CO., Springfield, Mass.; magnetos.

WILLET MFG. CO., Grand Rapids, Mich.; shoulder scraper for trucks; spring scraper; road and street sweeper; oil pump and clutch unit.

WINSLOW GOVERNMENT STANDARD SCALE WORKS, Terre Haute; aggregate scales; portable truck scales.

WIRE REINFORCEMENT INSTITUTE, Washington; wire highway reinforcing.

WISCONSIN AXLE CO., Oshkosh, Wis.; truck axles.

WISCONSIN FILL SETTLEMENT & EXPLOSIVE CO., Merrill, Wis.; fill sounding, sampling and boring machine.

WISCONSIN FOUNDRY & MACHINE CO., Madison, Wis.; crushers; crusher roll unit.

WISCONSIN MOTOR CO., Milwaukee; industrial motors.

WOOD HYDRAULIC HOIST & BODY CO., Detroit; hoists; dump bodies; oil heating units.

YORK MODERN CORP., Unadilla, N. Y.; road grader, reclaimer and rake; junior road grader.

YOUNG RADIATOR CO., Racine, Wis.; heating and cooling units.

ZENITH-DETROIT CORP., Detroit; carburetors; filters.

General

U. S. BUREAU OF PUBLIC ROADS.
U. S. BUREAU FOREIGN AND DOMESTIC COMMERCE.
SOUTH CAROLINA HIGHWAY DEPT.
NEW MEXICO HIGHWAY DEPT.
NEVADA HIGHWAY DEPT.
INDIANA HIGHWAY DEPT.
MEXICO HIGHWAY DEPT.
NEBRASKA HIGHWAY DEPT.
NATIONAL CAPITAL PARK AND PLANNING COMM'N.
A.R.B.A. HIGHWAY LOCATION COMM'N.
MICHIGAN HIGHWAY DEPT.
NEW JERSEY HIGHWAY DEPT.
MICHIGAN ROADS AND AIRPORTS.
WAYNE COUNTY BOARD OF ROAD COMM'R'S.
OHIO HIGHWAY DEPT.
23D ENGINEERS, HIGHWAY REGIMENT.